ARSON RISK ASSESSMENT

The Development of an Actuarial Model for Arson Recidivism

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ABSTRACT

The main aim of this thesis was to contribute to the understanding of arson offending in terms of arson risk factors, arson recidivism, arson actuarial risk assessment and whether arson recidivists are qualitatively different from other types of recidivists (such as violent and non-violent offenders). The findings from this thesis determined that second-generation actuarial tools can be successfully developed to predict rare offending events such as arson recidivism and more importantly become operationally viable tools to assist multiple sectors in the criminal justice system such as judicial, treatment, custodial, parole and investigations. Prior to our published work contained within this thesis (see chapter 2) there were no empirically developed, validated or publishable work in New Zealand (NZ) or internationally on second-generation actuarial tools for arson recidivism. This led to the overarching aim of this thesis which was to develop arson predictive models and arson actuarial tools to aid the prediction of arson recidivism in a New Zealand context. The research presented in this thesis sets the benchmark for researchers to replicate and develop future arson predictive models and operationalised actuarial risk assessment tools for arson recidivism within their respective jurisdictions.

Chapter one provides a literature review with the aim of presenting key arson research findings and how this background knowledge supports the overarching goal and aims of this thesis. In this chapter we define arson and its problem in the US, UK and NZ. We discuss the four generations of risk assessments as defined by Bonta (1996). In this sub-topic we discuss the Risk of re-Conviction and Risk of re-Imprisonment (RoC*RoI; Bakker, Riley, & O'Malley, 1999) as a preferred second-generation actuarial measure of choice for NZ offenders in a custodial setting. We progress to third generation approaches and review

several promising firesetting risk assessment tools. We complete this topic by discussing the Risk Need Responsivity Model (RNR; Bonta & Andrews, 2007) and how it guides second, third and fourth-generation risk assessment approaches. From here we discuss several firesetting theories; the Dynamic Behavioural Theory of Firesetting (DBToF; Fineman, 1980), Kolko and Kazdin (1986) social learning model and the Multi-Trajectory Theory of Adult Firesetting (M-TTAF; Gannon, Ó Ciardha, Doley, & Alleyne, 2012). We briefly touch on other recently developed micro-theories and UK firesetting intervention programmes (FIPP; FIP-MO) that are guided by the M-TTAF theory. Next, we discuss arson recidivism and arson risk factors from fifteen published arson studies (between 1978 and 2018) of which have guided and informed our research. From here we reviewed and compared the work of four key published researchers who have developed arson predictive models for arson recidivism (Rice & Harris, 1996; Edwards & Grace, 2014; Field, 2015; Ducat, McEwan, & Ogloff, 2015). Two of these publishers (Edwards & Grace, 2014; Field, 2015) have progressed and developed operationalised actuarial tools for arson recidivism. Last, we briefly discussed an arson classification table based on the style and type of offending (the serial, mass or spree arsonist).

Following this overview and background within the field, we progressed to chapter two which comprised of the original work by Edwards and Grace (2014). Given that there was no published research in the literature relating to second-generation arson actuarial development the rationale for conducting this original piece of research was certainly warranted and worthy of exploration. As such, chapter two was founded on this rationale which forms the complete chapter titled “The Development of an Actuarial Model for Arson Recidivism” (Edwards & Grace, 2014). Our work was based on previous research conducted by Rice and Harris (1996) who investigated mentally disordered arsonists. Using their research design as

a framework we developed empirical-based predictive models and actuarial tools for arson recidivism among NZ convicted arson offenders. Our research studied individuals who were prosecuted through the NZ criminal justice system for an arson-related offence in NZ between 1985 and 1994 (n = 1250). Over a 10-year follow-up, recidivism rates for arson were 6.2%, violent 48.5% and non-violent 79.3%. A major goal of this study was to develop predictive models for arson, violent and non-violent recidivism. The final predictors for the arson model were: First arson under 18-years, multiple arsons and having prior vandalism offences. In comparison, the final predictors for the violent model were: First arson under 18-years, age at first offence, number of prior violent and prior all offences; and for the non-violent model: Age at first arson, number of prior theft and number of prior drug offences.

Overall, these findings suggest that arson recidivists have specific-risk predictors that are not routinely found in violent and non-violent recidivists. It is concluded that arson recidivists are qualitatively different from offenders with non-arson criminal histories. The empirical evidence presented suggests that arson recidivists should be cautiously considered as a distinct and unique category of re-offending. For this reason, it is important to examine specific risk predictors that have been empirically validated to predict future arson offending. In terms of the model accuracy, the arson model is operating at a moderate level (AUC = .68) compared to the violent and non-violent models which are operating at slightly higher levels of predictive accuracy (AUC = .72 and .73, respectively).

The final goal of the study was to develop an operationalised second-generation actuarial risk assessment tool for identifying “high-risk” individuals who are significantly more likely to commit an arson offence in the future. The actuarial tool was based on the same three final risk predictors that generated the arson model with the defined risk scale varying from low to

high (0 to 10). The arson actuarial tool provided a moderate level of predictive accuracy (AUC = .67). These results hold great promise for clinicians and practitioners to incorporate the Edwards and Grace (2014) arson actuarial tool as part of their comprehensive risk assessment and case management plans for third and fourth-generation approaches. It is interesting to note that since the published work by Edwards and Grace (2014) other researchers such as Field (2015) have replicated and developed additional arson predictive models and arson actuarial tools using similar methodology by Edwards and Grace (2014).

In chapter three, we replicated the original work by Edwards and Grace (2014) and developed additional empirical-based predictive models for arson, violent and non-violent recidivism and a subsequent arson actuarial model. The rationale for this second study was to assess the generalisability and utility of the original Edwards and Grace (2014) model against a second arson cohort series (with no overlapping dates). To achieve this, we obtained and investigated a second NZ sample of arson offenders who were convicted of an arson-related offence in NZ between 1998 and 2008 (n = 1464) and a random sample of convicted violent (n = 1464) and non-violent offenders (n = 1464). Over a 5-year follow-up, recidivism rates for arson were 5.9%, for violence (violent sample) 51% and for non-violence (non-violent sample) 72.5%. Similarly, we identified and compared the final static risk predictors associated with arson, violent and non-violent recidivism. We developed predictive models for each recidivism type and identified the final predictors for the arson model were: First arson under 18-years and prior arson offences. We replicated and built a comparative second-generation actuarial tool for arson recidivism using the same three risk predictors used in the Edwards and Grace (2014) actuarial tool.

Overall, both the arson predictive model and the arson actuarial tool (in chapter 3) provided low levels of accuracy (AUC = .61 and AUC = .60, respectively). Nonetheless, the two final risk predictors for the arson predictive model are reasonably well supported risk factors (Field, 2015). Therefore, the utility of the arson predictive model and its risk factors is not in serious doubt and does provide support for the development of actuarial tools for arson recidivism. It is emphasised that fine tuning research designs, methodology, using prospective data and incorporating criminogenic and dynamic risk factors is highly recommended for greater predictive accuracy and enhanced actuarial development. Last, we determined from a Linear Discriminant Analysis (LDA) test that we cannot accurately classify or distinguish a group of arson offenders from a group of violent and non-violent offenders based solely on prior criminal histories. This suggests that arson offenders are not quantitatively different compared to violent and non-violent offenders when solely comparing prior criminal histories. This supports current research that arson offenders are more criminally versatile and are not pure arsonists (Ducat et al., 2015).

Lastly, the aim of the fourth chapter was to summarise the main findings from both empirical studies, its implications, future directions and limitations. We discuss and review the four critically important research questions under investigation. This chapter summarises the overarching goal, the aims within each chapter and highlights the operational utility of the Edwards and Grace (2014) tool for the NZ criminal justice system.

The overarching goal of this thesis was to

"*Develop an actuarial model and risk classification scale to aid the prediction of arson recidivism in a New Zealand context".*

The Rationale for this Thesis

To achieve this overarching goal, key aims for each chapter were proposed, some of these aims were progressive while other aims overlapped but were fundamental in driving the two empirical-based studies. The rationale for conducting the work presented in this thesis is that there were no published empirically developed second-generation actuarial tools for arson offenders. More specifically, there were no developed predictive arson models or arson actuarial tools for the wider population of convicted arson offenders in NZ or overseas. The original empirical study (chapter 2) focussed on three progressive aims while the second replicated empirical study (chapter 3) focused on the same aims from chapter two. The final chapter (chapter 4) brings together all the aims and rationales to support the overarching goal of this thesis. For clarification, the aims throughout this thesis with reference to each chapter are proposed:

The Aims of the Thesis

- The aim of the initial chapter was to provide a background overview of arson in terms of well supported and promising arson risk factors, arson recidivism and arson actuarial risk assessment. The key research findings discussed from the literature support the overarching goal and rationale of this thesis (chapter 1).

- The aim of the second chapter was to extend on the previous work conducted by Rice and Harris (1996) on mentally disordered firesetters and develop and validate empirically based predictive models for arson, violent and non-violent recidivism among the wider population of convicted NZ arson offenders (chapter 2).
- A secondary aim of this chapter was to identify, compare and discuss the final static risk predictors associated with arson, violent and non-violent recidivism (chapter 2).
- A third aim of this chapter was to use the three risk predictors generated from the arson predictive model and develop and validate a second-generation actuarial risk assessment tool for arson recidivism (chapter 2).
- The aim of the third chapter was to assess the generalisability and utility of the original Edwards and Grace (2014) tool. To achieve this, we developed additional empirical based predictive models for arson, violent and non-violent recidivism among convicted NZ arson, violent and non-violent offenders (chapter 3).
- A secondary aim of this chapter was to identify, compare and discuss the final static risk predictors associated with arson, violent and non-violent recidivism (chapter 3).
- A third aim of this chapter was to replicate the Edwards and Grace (2014) actuarial tool and build an additional second-generation actuarial risk assessment tool for arson recidivism (chapter 3).
- A fourth aim of this chapter was to identify whether we can accurately classify and distinguish a group of arson offenders from a group of violent and non-violent offenders and vice versa (chapter 3).
- The aim of the fourth chapter was to review the overarching goal, summarise all the aims, rationales, the four key research questions and identify the important practical implications and operational utility of the Edwards and Grace (2014) tool within the NZ criminal justice system (chapter 4).

The Research Questions for this Thesis

This thesis addresses four key foundational and critically important research questions which are fundamentally explored and discussed throughout this thesis and are summarised in chapter four. The four research questions with reference to each chapter are proposed:

1. Can actuarial tools be created to predict rare offending events such as arson offending? (discussed throughout each chapter).
2. Are individuals who commit arson qualitatively different from individuals with non-arson criminal histories? (discussed throughout each chapter).
3. To what degree should individuals who commit arson be assessed, managed and treated uniquely in the criminal justice system? (primarily discussed in chapters 1 and 4).
4. How can arson actuarial tools be used and who would benefit from using them? (primarily discussed in chapters 1 and 4).

CHAPTER ONE

The Aims of this Chapter

The primary aim of this chapter is to provide a background overview of offender risk assessment, narrowing down to arson risk assessment in terms of well supported and promising arson risk factors, arson recidivism and arson actuarial risk assessment. The key research findings discussed from this literature review supports and addresses the overarching goal and rationale of this thesis and at the same time provides a strong contribution to the field of arson risk assessment.

The Research Questions for this Chapter

The four critically important research questions are explored throughout this chapter. The research questions addressed in this chapter are: 1). Can actuarial tools be created to predict rare offending events such as arson offending? 2). Are individuals who commit arson qualitatively different from individuals with non-arson criminal histories? 3). To what degree should individuals who commit arson be assessed, managed and treated uniquely in the criminal justice system? 4). How can arson actuarial tools be used and who would benefit from using them?

1. LITERATURE REVIEW

The field of arson risk assessment is somewhat under-developed and does warrant further scientific and empirical exploration to align with other types of offending, such as violent and non-violent crimes. We start this chapter by defining arson, firesetting and pyromania, we discuss the arson problem in the US, UK and NZ. We explore further into firesetting in NZ and review demographics and arson conviction data obtained by the NZ Ministry of Justice (2019). Next, we discuss the four generations of risk assessments as defined by Bonta (1996). In this topic, we discuss one of NZ's most preferred second-generation actuarial tools by the NZ Department of Corrections, the RoC*RoI (Bakker et al., 1999). We discuss several promising and developing fire-specific risk assessment tools in the field. Next, we direct our attention to one of the most influential models which guides the assessment and treatment of offenders, the Risk Need Responsivity model (RNR; Bonta & Andrews, 2007). Following this, we discuss several firesetting theories and two UK firesetting intervention programmes (FIPP; Gannon et al., 2012, FIP-MO; Tyler, Gannon, Lockerbie, & O'Ciardha, 2018). We explore important published research (studies and reviews) over the last 40-years which have investigated arson recidivism and arson risk factors. We build on this topic and discuss arson risk assessment with reference to the four key published researchers who have developed arson predictive models and subsequent arson actuarial risk assessment tools (Rice & Harris, 1996; Edwards & Grace, 2014; Ducat et al., 2015; Field, 2015).

Last, we discuss arson classification by style and type (serial, mass or spree arsons) with reference to Douglas, Ressler, Burgess and Hartman (1986). Overall, the background knowledge presented in this chapter supports the overarching goal of this thesis: To develop an actuarial model and risk classification scale to aid the prediction of arson recidivism in a

New Zealand context. It is clearly evident that tools such as these are lacking in the literature, therefore, any attempt to propose or develop such arson actuarial tools will hold great promise for future operational use within the clinical, forensic, correctional and judicial settings.

The criminal justice system requires professionals to make accurate and well-informed predictions and risk assessments of individuals who pose a threat to the safety and security of the public and themselves. Whether those predictions are made in the judicial system, or parole boards or whether those predictions are made in a correctional or forensic setting. Making accurate and well-informed predictions serve an important role and holds great responsibility for accurately identifying "at risk" individuals who have the propensity and proclivity for committing future serious offences. The act of arson is undoubtedly one of those major crimes and problems we face around the world (Geller, 1992) and professionals alike are seeking ways to reduce and prevent such firesetting behaviours (Kennedy, Vale, Khan, & McAnaney, 2006).

Unfortunately, deliberate firesetting appears to be one of the least understood criminal behaviours (Davis & Lauber, 1999) and therefore does warrant further empirical exploration and investigation. To add to the complexities of criminal offending, firesetters are not clearly distinguishable from other types of offenders. That is, firesetters co-exist with an array of general offending (Hill et al., 1982; Rice & Harris, 1996; Soothill, Ackerley, & Francis, 2004). To commence this review, we will first define arson in the NZ context with reference to its legal definition.

Defining Arson

The term arson is a legal definition under section 267 of the New Zealand Crimes Act 1961 and is defined as:

(1) Everyone who commits arson is liable to imprisonment for a term not exceeding 14 years who –

A) Intentionally or recklessly damages by fire or explosives to any property that the person knows or ought to have known that danger to life is likely; or

B) Intentionally or recklessly, and without claim of right damages by fire or explosives any immovable property, vehicle, ship, or aircraft in which that person has no interest; or

C) Intentionally damages by fire or explosives any immovable property, or vehicle, ship, or aircraft with the intent to obtain benefit (benefit means any benefit, pecuniary advantage, privilege, property, service, or valuable consideration) or cause loss to another person.

In other international jurisdictions, the maximum penalty for arson is life imprisonment; Section 444 of the Criminal Code 1913 (The State of Western Australia) and the Criminal Damage Act 1971 (England). More generally, arson is described as the wilful and malicious burning of any type of persons property (DeHaan, 1991; Holmes & Holmes, 1996). To support criminality, DeHaan (1991) states that the definition of arson has three separate components: first, the burning of any type of property. For an arson prosecution, the court must be satisfied that there is some type of damage or destruction to any property. Second, the burning of any property must be incendiary, that is, all possible natural and accidental

causes can be ruled-out and discounted as a cause. Third, the element of malicious intent for deliberately destroying the property is proven (DeHaan, 1991).

There are several terms used by the NZ Fire Service (NZFS) and NZ Police that describe fires which have been deliberately started. Some of these terms have similar meanings and are used interchangeably throughout this thesis. Therefore, arson will be used to describe the specific legal offence (as defined under each jurisdiction), firesetting will be used to describe the behaviour of deliberate firesetting and pyromania will be used to describe the psychiatric disorder (DSM-5; American Psychiatric Association, 2013). To provide further clarification, these terms are discussed below:

Arson: Is a legal term used to describe a specific criminal offence (267 of the NZ Crimes Act 1961) or is used to describe the criminal act of deliberately setting a fire. Primarily incidents that have attracted the attention of the law are defined as arson. Arson may also be used as a tool to commit acts of murder (filicide) or cover-up a prior murder (crime concealment) or suicide (self-harm). From a legal perspective deliberately setting fire to an individual or a group is considered murder rather than arson, but such cases are rare in NZ and would not have been included in this thesis. Generally, the term arson is a legal and narrow definition which varies across many jurisdictions (Gannon & Pina, 2010). Often the term firesetting is used instead of arson to include undetected firesetting behaviours. Therefore, the terms arson and deliberate firesetting may be used interchangeably throughout the thesis to describe arsons and firesetting that have been deliberately, unlawfully and intentionally started.

Deliberate Firesetting (Unlawful): These are incendiary fires where all possible natural and accidental causes have been ruled out and at least one incendiary fire indicator is observed

(sections 19.2 and 19.3 of NFPA 921:2004). Firesetting is used to describe a specific behaviour of deliberately firesetting that are not legally authorised or sanctioned. That is, firesetting relates to all deliberate acts which are not recreational in nature. Generally, law refers to deliberate firesetting as arson and this may be defined more broadly as; the intentional destruction of property by unlawful purposes (Kolko, 2002; Williams, 2005). Therefore, this thesis focusses on fires that are deemed to be unlawful and have some type of criminality attached to it.

Deliberately Firesetting (Lawful): These fires are deemed to be lawful and are socially condoned such as controlled bonfires, controlled burns, camp cooking, rubbish burn-offs or for agricultural purposes.

Incendiary Fire: Is a fire where the physical evidence indicates that the fire was deliberately started or set alight (Cropp, 1992). This is also described as unlawful deliberately lit fires or intentional fires (Hall, 2005).

Suspicious Fire: This term refers to a fire where the circumstances indicate that it may have been deliberately set or started (Cropp, 1992). A suspicious fire is different from an incendiary fire and is determined by the level of proof required. By this, if there is insufficient evidence to determine a deliberately set fire but at least one incendiary fire indicator can be observed at the scene (sections 19.2 and 19.3 of NFPA 921:2004) the fire may be determined as suspicious.

Pyromania: Is a term is used to describe a specific psychiatric disorder. The diagnostic criteria for pyromania is defined under the Diagnostic and Statistical Manual of Mental

Disorders (DSM-5) and falls under the chapter of disruptive, impulse-control and conduct disorders (DSM-5; American Psychiatric Association, 2013). In order to be diagnosed with pyromania, an individual must present: The repeated intentional firesetting in the absence of all other motivators (motiveless acts) and is accompanied by an interest or fascination of fire. Further, there is some type of pre-empted emotional arousal gained from the fire which leads to gratification, relief or pleasure and not resulting from impaired judgement (such as intoxication) and is not associated with any of the antisocial personality disorders, conduct disorders, delusional or psychotic disorders. If it's not pyromania, arsonists may set fires due to other symptoms related to their psychiatric or personality disorders (Gannon & Pina, 2010; Ritchie & Huff, 1999).

A review conducted by Gannon and Pina (2010) identified that researchers had either no pyromaniacs in their samples or the rates are rare and vary between 3% to 10%. Other reports indicate that pyromania has a low diagnostic rate within clinical populations (Rice & Harris, 1991). Further, Lindberg, Holi, Tani, and Virkkunen (2005) reported that pyromania is not a common diagnosis among their sample of arsonists, hence only a small percentage of arsonists meet the full diagnostic criteria. Out of 90 arson forensic psychiatric patients in their study, only 3% met the diagnostic criteria for the disorder. Williams (2002) suggests that less than 2% of all arsonists including those in the wider arson population would receive a diagnosis for pyromania, this is due to the strict diagnostic criteria. The diagnostic criteria for pyromania (DSM-5) appears to be too restrictive in its current definition and is viewed as outdated (Ducat et al., 2015). In this thesis, it was not possible to identify those who may be clinically diagnosed with the disorder.

As one group of researchers explains: “Firesetting is a behaviour, arson is a crime, and pyromania is a psychiatric diagnosis” (Burton, McNiel, & Binder, 2012).

Now that we have defined arson and firesetting in a legal context and discussed some key terms including pyromania, we will now review the extent of the arson problem in the US, UK and NZ.

The US Arson Problem

The US per capita basis has one of the most severe fire problems in the world (Geller, 1992). In the last decade, US Fire Departments estimated 282,600 deliberately and intentionally set fires each year between 2007 and 2011 (Campbell, 2014). During this period, the US suffered on average 240 fatalities, 1,360 non-fatal injuries and an estimated US$1.3 billion dollars of property damage each year (Campbell, 2014). Although, no dollar amount can account for the reported high loss of life and injury in the US. In terms of deliberate firesetting in the US, in 2012 the Federal Bureau of Investigation (2012) estimated that of the 1,375,000 reported fires 45,926 of those were deemed to be deliberately started (Karter, 2014).

To appreciate the extent of the arson problem in the US it is important to understand how this data is collected and obtained. The two main Federal agencies that manage arson data is the National Fire Protection Association (NFPA) and the Federal Bureau of Investigation (FBI). The NFPA collects data for all structural fires, victims and statistical trends from all arson and suspicious fires across the US (Icove, Wherry, & Schroeder, 1980). The FBI as part of the annual Uniform Crime Reporting (UCR) collects data from local law enforcement agencies (Holmes & Holmes, 1996). The FBI’s UCR programme in 2011, identified that 20%

of all arsons logged were resolved by way of arrests (Federal Bureau of Investigation, 2011). Further, 33% of those charged arsonists were under 18-years of age, suggesting that the majority of all those detected (67%) were adult arson offenders (Federal Bureau of Investigation, 2011). It is reported in the US that one in ten fire casualties are the result of a deliberately lit structural fire (Karter, 2006).

The detection and conviction rates of arson in the US are extremely low with reports indicating that only about 3% of all arson offences lead to an arson conviction (Quinsey, Harris, Rice, & Cormier, 2006a). Therefore, arson rates that are based on arrest statistics and court outcomes are not a true reflection of the extent of the arson problem. Further, the NFPA states that arson is an extremely difficult crime to solve and prosecute (Hart, 1990; Icove et al., 1980) and does lead to very low conviction rates compared to other types of crime (Icove et al., 1980; Munday, 2000). In 2013, the percentage of violent-related crimes cleared by arrests in the US was; approximately 20.7% for arsons, compared with homicides which had a clearance rate of 64.1%, rapes of 40.6%, robberies of 29.4%, aggravated assaults of 57.7% and 48.1% for all violent types of crime (Federal Bureau of Investigation, 2014). These figures indicate that arson offending had the least cleared arrest rates compared to other violent-related offences such as homicides, rapes, robberies, aggravated assaults, and all types of violent crimes.

The US has also experienced one of the worst atrocities of deliberately lit fires with the attack on the World Trade Centre in which several commercial aircrafts containing some thirty tonnes of aviation fuel (introduced fuel load) crashing into buildings. This puts attacks such as these on similar standing to the bombings of buildings which are deemed low probability but high consequence events (Stone, 2004).

The UK Arson Problem

In the UK (includes England), fire services attended approximately 212,500 fires during the 2013 and 2014 period (Department for Communities and Local Government, 2015). Of these attended fires, 322 resulted in fatalities, 21,900 were reported as deliberately started; of these deliberate started fires, 70 resulted in fatalities and 1,300 suffered injuries (Department for Communities and Local Government, 2015). Of the 88,500 deliberately started fires, half of these were from dwellings of which 39 of the 70 reported fatalities occurred. In the UK, about one in six fire casualties are the direct result of a deliberately started structural fire (Home Office, 1999). These figures represent the whole of the UK combined which includes England.

If we take a snapshot of England alone and discuss the rates separately, the human and financial cost of deliberate firesetting still remain high. During the same period (2013 to 2014) fire services in England attended approximately 170,000 fires of the total 212,500 fires reported in the UK (Department for Communities and Local Government, 2015). Of these, 275 resulted in non-suspicious fire fatalities, 77,500 fires were determined as deliberate and Police reported at least 18,579 of those fires were arsons (Office for National Statistics, 2014); of these, 64 resulted in suspicious fatalities and 3,600 suffered injuries (Department for Communities and Local Government, 2015). Of note, about half of all attended fires in England are reported as deliberate and those fire-related incidents account for about 25% of all fire-related fatalities (Department for Communities and Local Government, 2014).

In 2008, the overall financial cost of fires in England was estimated at 8.3 billion pounds and the annual economic cost of arson was estimated at about 1.7 billion pounds (Department for

Communities and Local Government, 2011). As part of the overall cost, about 345 million pounds was allocated to the criminal justice system (Arson Prevention Forum, 2014). Now that we have captured the arson problem in the US and UK, we will now discuss the arson problem in NZ over the last three decades.

The NZ Arson Problem

The full extent of the arson problem in NZ is far from known, as was first noted back in the 1980's (Roberts, 1985). At that time, an alarming upward trend was seen (Roberts, 1985) with an increasing estimate rate of about 12.5 percent each year (Raea, 1985). In 1987, the NZ arson rate was 44 per 100,000 people which was similar to the US rate of 49.6 per 100,000 (Cropp, 1992). Arson in NZ was seen as reaching epidemic proportions to a point where local authorities were investigating deliberately started fires across the country at a rate of four per day (Raea, 1985).

In 1984, the NZ Police investigated 1,226 arson-related cases, representing greater than 50 percent increase since 1980. The NZ Fire Service (NZFS) attended 8,500 property fires and 5.5 percent of those were deemed to be arson (Raea, 1985). The NZFS suggests that arson figures are conservative, with realistic arson rates being more around 20 percent (Raea, 1985). The NZ insurance companies further support this suggesting that arson figures for all property-related fires in NZ are above 20 percent (Firefighter, 1983). Moving forward some two decades, in the 12-months following July 2004 (the NZ fire service year) the NZFS attended 21,859 fire-related incidents (Emergency Incident Statistics, 2005). Of those fires attended, 6,487 were structural fires, of which 1,013 (15.6%) were deemed as deliberately started fires (Emergency Incident Statistics, 2005). These figures suggest that since 1980, NZ

has seen an increase in NZFS attendance and an increase in deliberately started structural fires (1980 to 2005). Although, between 2000 (14.4%) and 2005 (15.6%) the proportion of deliberately started structural fires has remained relatively constant as reported in the NZ National fire statistics.

In another snapshot period using the NZ Fire Incident Reporting System database records (FIRS), between 1996 and 2006 there were 72,539 structural fires attended by the NZFS, of those, 9,606 (13.3%) were deemed deliberately started fires, this averaged about 17 structural fires per week were deliberately started. Further, 28 fatalities (10.6% of the overall fatality toll), 157 sustained life-threatening to moderate injuries (9.8% of the total structure injury rate) and 127 sustained slight injuries during the same period. These findings reflect that deliberately started fires are well under-represented on overall fire fatality and injury rates. Therefore, supporting the belief that the act of arson is a crime primarily against property and not so much against a person.

As with the US, it is indicated that NZ has extremely low arson detection and conviction rates (Roberts, 1985). It would be prudent to rely solely on NZFS statistics to describe the full extent and magnitude of the arson problem (Roberts, 1985). Unfortunately, as with other crime types not all arson-related offences come to Police attention or is reported to the local authorities (Roberts, 1985).

However, based on what we do know from past data (Roberts, 1985; Raea, 1985) and most current information obtained by the NZ Ministry of Justice (2019) we are able to determine whether arson convictions are on the rise and provide a critical evaluation on convicted arson offenders over the last 34-years.

As shown in Table 1, the number of individuals convicted in NZ for an arson-related offence between 1 January 1985 to 31 December 2018 were approximately 4,673. This on average, identified that about 137 individuals per year or 3 individuals per week were convicted of an arson-related offence in NZ. In 2008, we saw the highest number of recorded convicted arson offenders (*n* = 197) and in 2017, we saw the lowest number of recorded convicted arson offenders (*n* = 87). Of note, table 1 does limit the yearly count to only new arsonists convicted for each year and may omit counts of arsonists who may have been charged in multiple years or limit each recidivist per year to a single entry.

Therefore, caution should be exercised when reviewing this data and assessing the prevalence of convicted arson offenders by year (1985 to 2018) as this may not be an accurate representation and some cases may be excluded in the years they re-committed arsons. Although, the methodology employed by the NZ Department of Justice of its data collection would not overly impact these findings given that most convicted arson offenders are first time or "one-off" arson offenders. The main purpose for presenting table 1 is to provide a sense of the scope of arson offenders who were convicted in NZ per calendar year.

Table 1

The Number of Individual's Convicted of Arson from 1985 to 2018

Year	Convicted *n*
1985	126
1986	157
1987	136
1988	127
1989	147
1990	104
1991	109
1992	122
1993	118
1994	136
1995	131
1996	137
1997	145
1998	188
1999	132
2000	126
2001	150
2002	127
2003	149
2004	149
2005	150
2006	150
2007	153
2008	197
2009	180
2010	177
2011	125
2012	139
2013	151
2014	111
2015	123
2016	101
2017	87
2018	113

Note.

1. Total convicted for arson, $n = 4673$.
2. This data consists of the number of people convicted for at least one arson charge since 1985.

3. If a person is convicted of multiple arson charges, they are counted by the calendar year of their first convicted charge after 1985. Of note, this table does limit the yearly count only to new arsonists and may omit counts of arsonists who may be charged in multiple years.
4. As confirmed by the NZ Ministry of Justice (2019) the agency was unable to replicate previous arson data tables which counted cases.
5. This arson data is adapted with permission from the NZ Ministry of Justice (2019). (see Appendix A).

The overall prosecution outcomes for those charged with arson from 1985 to 2018 are shown in table 2. This table provides a breakdown of those individuals who were either convicted, other proved, not proved or other in Youth Courts, Magistrate Courts, District or Supreme Court matters (total prosecution numbers each year from 1985 to 2018 are provided).

Table 2

The Prosecution Outcomes for those Charged with Arson from 1985 to 2018

Year	Convicted	Other Proved	Not Proved	Other	Total
	n	***n***	***n***	***n***	***n***
1985	126	19	43	3	191
1986	159	40	41	1	241
1987	138	27	35	1	201
1988	134	24	58	5	221
1989	152	29	59	9	249
1990	117	10	57	4	188
1991	114	15	56	5	190
1992	127	13	49	0	189
1993	132	32	72	5	241
1994	148	31	89	2	270
1995	142	30	86	6	264
1996	143	35	84	6	268
1997	154	33	98	5	290
1998	200	31	100	7	338
1999	147	31	91	3	272
2000	138	56	105	3	302
2001	164	37	101	6	308
2002	136	34	96	6	272
2003	159	56	96	5	316
2004	164	63	115	8	350
2005	167	86	118	5	376
2006	156	71	143	3	373
2007	167	67	139	8	381
2008	212	65	132	8	471
2009	194	51	137	5	387
2010	187	54	108	5	354
2011	132	55	80	9	276
2012	149	52	84	7	292
2013	170	41	89	10	310
2014	126	40	52	14	232
2015	135	38	43	14	230
2016	111	42	45	12	210
2017	95	34	28	12	169
2018	117	24	26	15	182

Note.

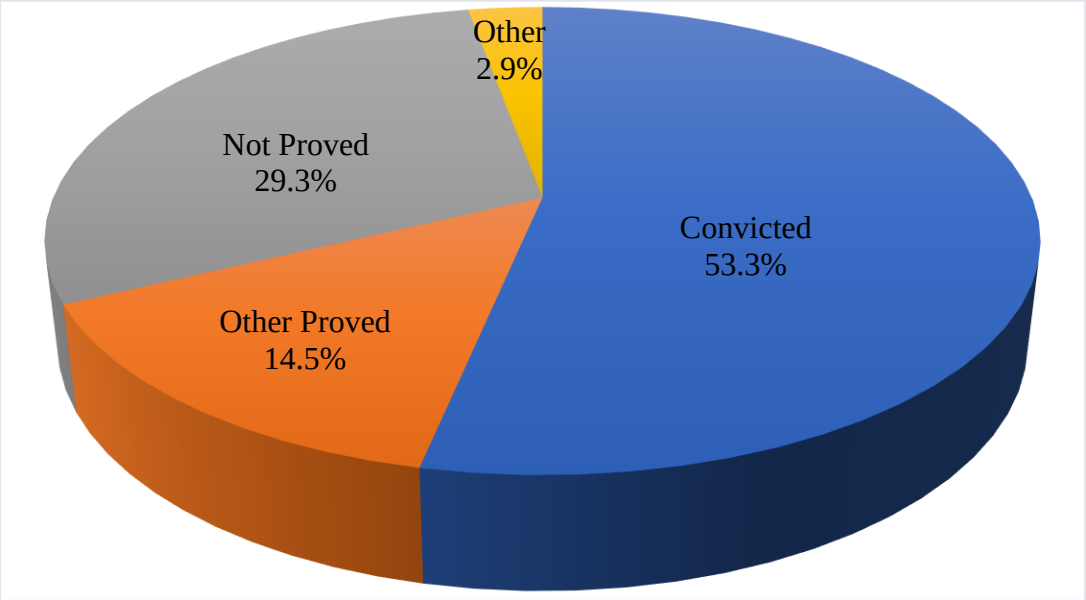
1. Total prosecution outcomes, $n = 5012$ (convicted), $n = 1366$ (other proved), $n = 2755$ (not proved) and $n = 271$ (other).

2. This data consists of the number of people charged for at least one arson offence.
3. If a person receives multiple arson charges, they are counted in each calendar year that they received a charge outcome.
4. A person is counted for the outcome of their most serious arson charge per each calendar year.
5. The outcome of a prosecution – whether a person is convicted or not:
    - Proved outcomes (where a person is found or pleads guilty) includes "convicted" and "other proved" (Youth Court proved, s. 283 order).
    - Those persons not convicted, include "Discharged" without a conviction or received a "Diversion" programme without a conviction. For youth offenders (proceeded in youth court) received a "Discharged" without a conviction.
    - Not proved outcomes includes the person being found not guilty and where the charge is withdrawn or dismissed.
    - Other charge outcomes including being found not guilty by reason of insanity or unfit to stand trial.
6. This arson data is adapted with permission from the NZ Ministry of Justice (2019). (see Appendix A).

A total of 9404 individuals were charged for an arson-related offence from 1985 to 2018. Of these, *n* = 5012 (53.3%) were convicted, *n* = 1366 (14.5%) were other proved, *n* = 2755 (29.3%) were not proved and *n* = 271 (2.9%) individuals were identified as other (found not guilty by reason of insanity or unfit to stand trial). Overall, these findings suggest that those individuals who were processed through the judicial system for an arson-related charge only about half of all cases (53.3%) resulted in an arson conviction. If we combine the "Convicted" and "Other Proved" prosecution outcomes about two-thirds (67.8%) of all arson-related cases are proven in court. The percentage of individuals charged by court outcome for arson are also presented in figure 1.

Figure 1

Percentage of Prosecution Outcomes for Arson from 1985 to 2018



Note.

1. Total prosecution outcomes for arson *n* = 5,012, of these, 53.3% (convicted), 14.5% (other proved), 29.3% (not proved) and 2.9% (other and includes found not guilty by reason of insanity or unfit to stand trial).
2. This arson data is adapted with permission from the NZ Ministry of Justice (2019). (see Appendix A).

Table 3 presents the number of individuals convicted of an arson-related offence by gender from 1985 to 2018. In total, 4333 males were convicted of an arson-related offence during this period, this indicates on average about 127 male's per year were convicted for an arson offence. In comparison, about 679 females were convicted of an arson-related offence during the same period, further indicating about 20 female's per year were convicted for arson in NZ. In 2008, the highest number of convicted male arson offenders (*n* = 179) was reported and in 2017 the lowest number of convicted male arson offenders (*n* = 79) was reported, this is consistent with table 1. As for females, 2008 and 2013, reported the highest number of convicted female arson offenders (*n* = 33) and 1985 reported the lowest number of convicted

female arson offenders (n = 9). Overall, during the 34-year period, 86.5% of those convicted for arson were male and 13.5% were female. These figures suggest that males are over-represented in arson populations and disproportionately out number female arsonists by a ratio of 9:1. This is consistent with the arson literature and is the same gender ratio findings of 9:1 as reported for young firesetters (Muller, 2008).

Of note, table 3 only counts or includes individuals for their most serious charge in any respective calendar year (from 1985 to 2018) and may omit individuals with simple or minor related offences. Thus, the information provided may not reflect the actual extent of the prevalence of the arson problem. Therefore, based on the data presented, caution should be exercised when reviewing this table and assessing the prevalence of arson offenders by gender each year during this period. The purpose of presenting table 3 is only to provide an indication of the scope of the arson problem by gender by each calendar year. Of interest, if we compare the overall number of individuals from table 1 to the sum over the years of the individuals in table 3 we obtain an indication of arson reoffending over that total period.

Table 3

The Number of Individual's Convicted of Arson by Gender from 1985 to 2018

Year	Male	Female	Total
	n	***n***	***n***
1985	117	9	126
1986	139	20	159
1987	123	15	138
1988	118	16	134
1989	139	13	152
1990	106	11	117
1991	103	11	114
1992	116	11	127
1993	117	15	132
1994	126	22	148
1995	119	23	142
1996	125	18	143
1997	138	16	154
1998	176	24	200
1999	132	15	147
2000	121	17	138
2001	137	27	164
2002	117	19	136
2003	136	23	159
2004	142	22	164
2005	145	22	167
2006	136	20	156
2007	141	26	167
2008	179	33	212
2009	167	27	194
2010	163	24	187
2011	108	24	132
2012	118	31	149
2013	137	33	170
2014	113	13	126
2015	115	20	135
2016	90	21	111
2017	79	16	95
2018	95	22	117

Note.

1. Total convicted by gender, $n = 5012$, $n = 4333$ (male) and $n = 679$ (female).

2. This data consists of the number of people charged for at least one arson charge.
3. If a person is convicted of multiple arson charges, they are counted in each calendar year that they received a convicted charge outcome.
4. A person is counted by the gender recorded for their most serious convicted arson charge that year. This data may omit individuals for simple or minor offences in each calendar year and capture their most serious arson conviction only.
5. As confirmed by the NZ Ministry of Justice (2019) the agency was unable to replicate previous arson data tables which counted cases. Thus, counting an individual once per year for their most serious charge (limiting to the specific offence types) is the agencies standard and preferred method for counting individuals.
6. This arson data is adapted with permission from the NZ Ministry of Justice (2019). (see Appendix A).

Table 4 presents 5012 individuals convicted for arson by ethnicity (European, NZ Māori, Pacific Peoples, Asian, Other and Unknown) between 1985 and 2018. It is reported that *n* = 3,116 (62.1%) were of "European" descent, this averaged about 92 individuals per year were of European background. *n* = 1,554 (31%) were of "NZ Māori" descent, averaging about 46 individuals per year were affiliated as NZ Māori. For "Pacific Peoples" *n* = 217 (4.3%) were convicted for arson, for the "Asian" group, *n* = 53 (1.1%) were convicted, the "Other" group (persons not consumed by the four main ethnic groups) had a total of *n* = 48 (1%) and the "Unknown" group comprised of *n* = 24 (0.5%) individuals. Overall, the ratio for European to NZ Māori is 2:1 and when combining both main ethnic groups represents over 93% of all convicted arson offenders being affiliated to the two main ethnic groups. The remaining four ethnic groups account for about 6.9% of the minorities over the same period. These demographics are also presented in figure 2.

Table 4

The Number of Individual's Convicted of Arson by Ethnicity from 1985 to 2018

Year	European	NZ Māori	Pacific	Asian	Other	U/K	Total
	n	***n***	***n***	***n***	***n***	***n***	***n***
1985	88	29	8	0	0	1	126
1986	110	43	2	0	3	1	159
1987	90	42	3	1	1	1	138
1988	80	50	4	0	0	0	134
1989	110	38	3	1	0	0	152
1990	72	41	1	0	2	1	117
1991	73	36	3	0	1	1	114
1992	78	38	7	2	1	1	127
1993	94	30	5	1	0	2	132
1994	85	56	5	0	1	1	148
1995	90	39	8	2	2	1	142
1996	91	41	7	2	2	0	143
1997	90	49	10	1	3	1	154
1998	135	50	10	0	4	1	200
1999	92	43	8	3	1	0	147
2000	92	34	8	3	1	0	138
2001	97	56	9	0	2	0	164
2002	90	32	9	4	1	0	136
2003	105	45	5	2	2	0	159
2004	100	57	3	2	2	0	164
2005	100	49	11	2	4	1	167
2006	97	47	7	2	2	1	156
2007	90	65	7	0	4	1	167
2008	133	69	7	1	0	2	212
2009	116	65	7	1	1	4	194
2010	112	63	10	2	0	0	187
2011	83	35	8	2	4	0	132
2012	94	43	8	2	2	0	149
2013	92	60	9	7	1	1	170
2014	81	35	4	5	0	1	126
2015	79	42	10	3	1	0	135
2016	63	46	2	0	0	0	111
2017	50	41	2	1	0	1	95
2018	64	45	7	1	0	0	117

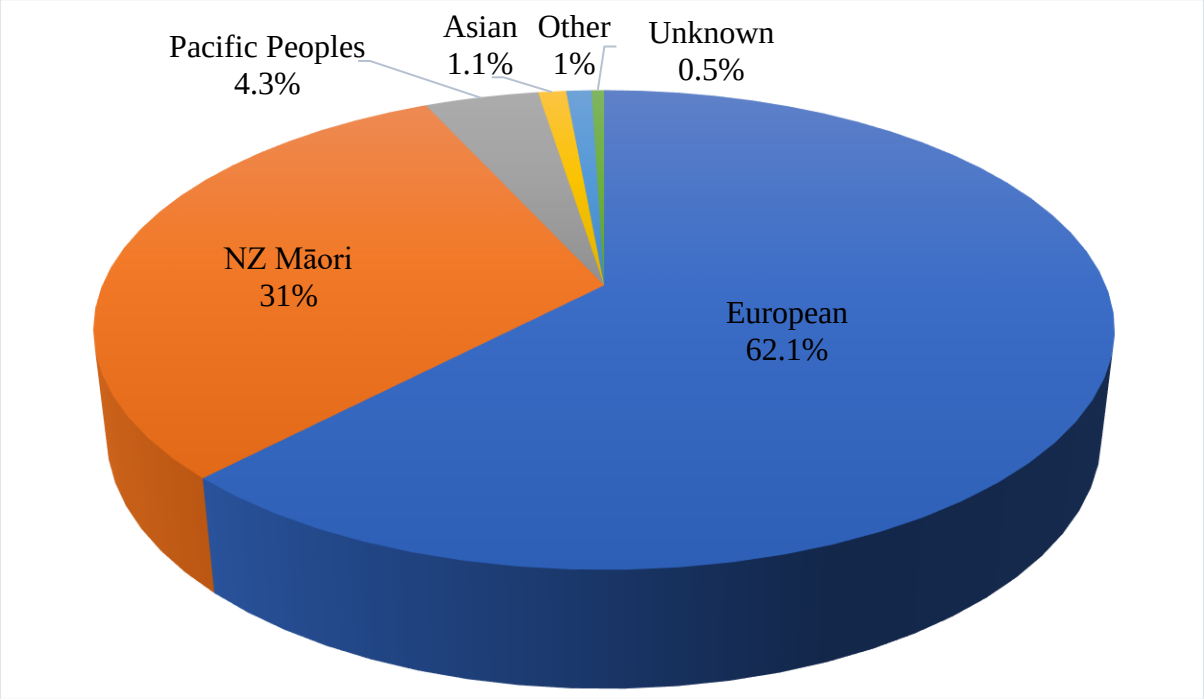
Note.

1. Total convicted by ethnicity *n* = 5012, *n* = 3116 (European), *n* = 1554 (NZ Māori), *n* = 217 (Pacific Peoples), *n* = 53 (Asian), *n* = 48 (Other) and *n* = 24 (Unknown).

2. This data consists of the number of people convicted of at least one arson charge.
3. If a person is convicted of multiple arson charges, they are counted in each calendar year that they received a convicted charge outcome.
4. A person is counted by the ethnicity recorded for their most serious convicted arson charge of that year.
5. This arson data is adapted with permission from the NZ Ministry of Justice (2019). (see Appendix A).
6. U/K is unknown ethnicity at the time of their arson conviction.

Figure 2

Percentage of People Convicted by Ethnicity for Arson from 1985 to 2018



Note.

1. Total convicted for arson by ethnicity *n* = 5012, of these, 62.1% (European), 31% (NZ Māori), 4.3% (Pacific Peoples), 1.1% (Asian), 1% (Other) and 0.5% (Unknown).
2. This arson data is adapted with permission from the NZ Ministry of Justice (2019). (see Appendix A).

Next, we investigate the number of individual's convicted of an arson offence by age group between 1985 to 2018, this is presented in table 5. The age groups are broken down into;

under 19-years, 20-29 years, 30-39 years, 40-49 years, 50-59 years and 60+ years. For the under 19-year age group, *n* = 1654 (33%) were convicted of an arson offence, this averaging about 49 youth/children were convicted per year. For the 20-29 age group, *n* = 1862 (37.2%) were convicted, which averaged about 55 per year. For the 30-39 age group, *n* = 858 (17.1%) were convicted, averaging 25 per year. For the 40-49 age group, *n* = 449 (9%) were convicted, averaging 13 per year. For the 50-59 age group, *n* = 147 (2.9%) were convicted, averaging 4 per year. Last, for the 60+ age group, *n* = 37 (0.7%) were convicted, averaging about 1 per year and the remaining *n* = 5 (0.1%) individuals did not have their age recorded at the time of their arson offence. Overall, these findings suggest that the age group committing the most arsons on average were the 20-29-year group, followed closely by the under 19-year group. Further, if we combine both the under 19-year group and 20-29-year age group, *n* = 3516 were convicted of arson, this combined total represents over 70% of all individuals convicted of arson were juvenile to 29-years age groups. The data also suggests that as the age groups increase the percentage of those convicted for arson significantly decrease. These demographics are further presented in figure 3.

Table 5

The Number of Individual's Convicted of Arson by Age Group from 1985 to 2018

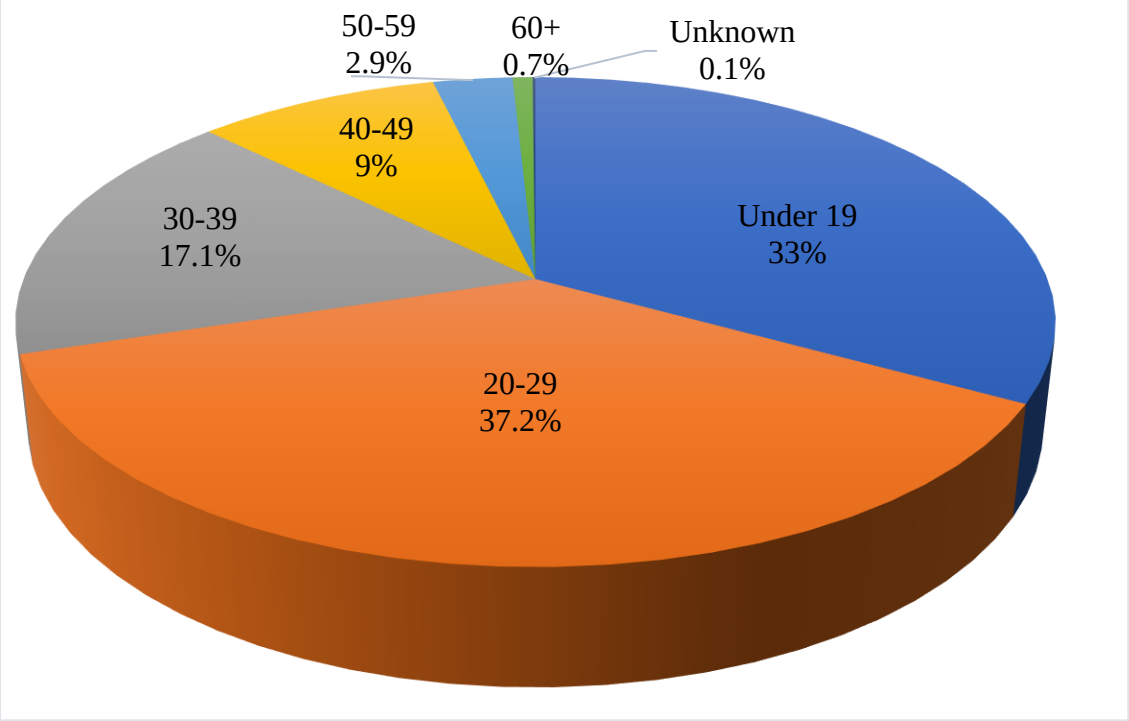
Year	<19	20-29	30-39	40-49	50-59	60+	U/K	Total
	n	*n*	*n*	*n*	*n*	*n*	*n*	*n*
1985	60	41	15	8	2	0	0	126
1986	69	66	17	5	2	0	0	159
1987	52	61	16	5	4	0	0	138
1988	52	47	23	5	5	2	0	134
1989	63	58	21	7	2	1	0	152
1990	35	48	23	9	2	0	0	117
1991	45	53	11	4	1	0	0	114
1992	39	61	16	8	2	1	0	127
1993	44	59	22	4	1	1	1	132
1994	48	69	21	8	0	1	1	148
1995	48	62	18	12	1	0	1	142
1996	51	57	25	8	2	0	0	143
1997	45	71	27	7	4	0	0	154
1998	70	76	36	11	6	1	0	200
1999	50	63	24	9	1	0	0	147
2000	45	53	25	14	1	0	0	138
2001	48	55	37	21	3	0	0	164
2002	34	52	25	15	8	2	0	136
2003	51	49	37	18	2	2	0	159
2004	67	51	31	13	2	0	0	164
2005	57	53	34	15	8	0	0	167
2006	61	44	28	18	4	1	0	156
2007	57	58	33	13	4	2	0	167
2008	78	56	39	29	7	3	0	212
2009	73	68	31	11	10	0	1	194
2010	81	57	30	14	3	2	0	187
2011	39	54	13	18	5	3	0	132
2012	47	52	27	17	4	2	0	149
2013	43	56	26	30	12	3	0	170
2014	26	45	17	25	11	1	1	126
2015	20	53	30	21	6	5	0	135
2016	18	44	29	12	7	1	0	111
2017	18	29	21	17	8	2	0	95
2018	20	41	30	18	7	1	0	117

Note.

1. Total convicted for arson, *n* = 5012, *n* = 1654 (<19 years), *n* = 1862 (20-29 years), *n* = 858 (30-39 years), *n* = 449 (40-49 years), *n* = 147 (50-59 years), *n* = 37 (60+ years) and *n* = 5 (unknown years).
2. This data consists of the number of people convicted of at least one arson charge.
3. If a person is convicted of multiple arson charges, they are counted in each calendar year that they received a convicted charge outcome.
4. Age is the person's age at the offence date of their most serious convicted arson charge that year.
5. This arson data is adapted with permission from the NZ Ministry of Justice (2019). (see Appendix A).
6. U/K is unknown age at the time of their arson conviction.

Figure 3

Percentage of People Convicted for Arson by Age Group from 1985 to 2018



Note.

1. Total convicted for arson by age group *n* = 5012, of these, 33% (under 19 years), 37.2% (20-29 years), 17.1% (30-39 years), 9% (40-49 years), 2.9% (50-59 years), 0.7% (60+ years) and 0.1% (unknown years).

2. This arson data is adapted with permission from the NZ Ministry of Justice (2019). (see Appendix A).

Firesetting in New Zealand

Based on the information obtained by the NZ Ministry of Justice (2019) what can we conclude about firesetting in NZ? On average about five individuals each week are charged for an arson-related offence and of these cases, about three result in a prosecution (conviction). The findings indicate that there is no upward or downward trend over the last 34-years of convicted arson offenders other than sporadic conviction numbers throughout this period (1985 to 2018) but averaging about 137 individuals each year are convicted for arson. Of the 9404 individuals charged for an arson-related offence and brought before the judicial system, just over half (53.3%) were convicted for their arsons, 14.5% were proven in court and 29.3% were not proven in court and 2.9% were found not guilty by reason of insanity or unfit to stand trial. If we combine these findings, 67.8% (n = 6378) of those processed by the judicial system were subsequently convicted and proven in court and were deemed criminally responsible for their arsons. Therefore, it is proposed that this combined group of arson offenders best reflects the wider population of convicted arson offenders in NZ.

Interestingly, NZ arson resolution and clearance rates (conviction or proven court outcomes) are significantly higher compared to overseas rates such as the US and NZ has shown to be a forefront in high arson conviction and prosecution rates. In comparison, the detection and conviction rates in North America are extremely low, indicating that only about 3% of all arson charges result in an arson conviction (Quinsey et al., 2006a). Of note, for the small number of cases, 2.9% (n = 271/9404) had diminished responsibility for their arsons due to psychiatric reasons. If pyromania had been used as a defence in NZ for their arsons it would

likely fit within this small and unique subgroup of individuals, unfortunately this specific type of data was not included in the dataset provided. Therefore, further research is clearly warranted for mentally disordered arsonists with diminished responsibility (see Barnett, Richter, Sigmund, & Spitzer, 1997).

If we address gender differences, 86.5% of all those convicted for arson in NZ were male and 13.5% were female. These figures indicate that males are generally over-represented in arson populations and disproportionately outnumber female arsonists by a ratio of 9:1. These figures are consistent with the arson literature, particularly youth firesetting. For ethnicity, 62.1% were of European descent and 31% were of NZ Māori descent. The ratio of European to NZ Māori is 2:1, but when combining both main ethnic groups represents over 93% of all convicted arson offenders in NZ between this period.

It is interesting to note that European males are overly represented in the wider population of arson offenders compared to NZ Māori offenders, when typically, NZ Māori males are over-represented in violent and non-violent crimes (see chapter 3) compared to their European counterparts. Currently, there is no existing literature to support or explain these ethnic differences based on various offence types, although cultural reasons may play a role, further exploration is clearly warranted. In sum, based on the limited demographic information available, statistically the typical convicted arson offender in NZ would likely be male of European descent, aged between 14-29 years of age and if charged likely to be prosecuted, convicted and generally reflect the wider population of convicted arson offenders in NZ.

The Rationale

What we have learned about firesetting in NZ is that the act of arson is prevalent in NZ and has been for many decades. On average about 276 individuals are charged for an arson-related offence in NZ each year, these concerning figures combined with the devastation that arson leaves behind plays an important role in public health and safety, national security, the criminal justice system (judicial, treatment, custodial, parole and investigations) and also the rights and liberties of those convicted for arson. Despite these overwhelming statistics, this type of criminal behaviour remains poorly understood, in particular, identifying specific risk factors for those small but persistent group of arsonists who continue to set fires. This remains a highly important societal and national security issue given that some repeat arsonists do not stop lighting fires until they are caught. Alarming reports indicate that serial arsonists may set up to 31 fires until they are eventually apprehended or caught (Sapp, Huff, Gary, Icove, & Horbert, 1994). Further to this complex issue that there are limited specialist assessment and intervention programmes to support and treat convicted arson offenders. Further, the lack of empirically validated risk assessment tools for arsonists presents serious ethical and practical issues for clinicians and legal experts who are tasked with providing such evidence-based and defensible risk assessment recommendations in the criminal justice system and forensic or clinical settings.

Therefore, there is a need for further investigation, research and development in the field of arson risk assessment. This type of work will ultimately enhance and doctrine evidence-based approaches in NZ with the long-term goal of assessing and treating arsonists. Of note, researchers do advise caution when relying on risk assessment tools for groups that are not widely represented in the samples from which they were originally developed and validated

on. Therefore, it is important that any work conducted in NZ does capture the wider criminal population of convicted arson offenders, the previous data discussed indicates that most arson offenders are processed by the judicial system. These include individuals who serve prison sentences and those on community-based orders or on probation. Any developed arson tools in NZ would be culturally specific and best reflect the group of convicted arson offenders within the NZ context.

One scientific approach to address the gaps within the field is to develop and valid accurate empirically based second-generation actuarial models and operationalised risk classification scales for convicted arson offenders (see chapter 2). As noted in the arson literature, there is a pressing need to develop such actuarial tools for arson recidivists. However, no such work or development existed in the literature until the Edwards and Grace (2014) published work (see chapter 2).

Now that we have discussed the arson problem in the US, UK and NZ and provided a summary of the arson conviction data in NZ over the last three decades. We will now focus our attention to the field of offender risk assessment. More specifically, we will commence this topic by introducing an overview of the four-generations of risk assessments as originally defined by Bonta (2006). This topic will capture promising second-generation arson actuarial tools and emerging third and fourth generation arson and firesetter risk instruments.

Offender Risk Assessment (The Four Generations)

Predicting criminal behaviour is one of the most fundamental and important aspects of the criminal justice system (Andrews & Bonta, 2003) and there has been significant work in

developing risk-screening tools for predicting criminal recidivism (Silver, Smith, & Banks, 2000). Any developments for assessing offender risk supports key initiatives of community safety, crime reduction and rehabilitation (Kim, Joo, & McCarty, 2008). A risk assessment tool is used to determine the level of predicted "risk" for any individual at any given time. For example, if an individual possesses several risk factors that are empirically associated with dangerousness that individual will likely be deemed as "high-risk" compared to individuals with fewer risk factors and would be deemed "low-risk". Further, risk assessment tools may identify individual's criminogenic needs or dynamic risk factors for appropriate psychological intervention. This will help identify the key risk factors or targets for change associated with the specific type of offending behaviour. Bonta and Andrews (2007) states the best and most effective way of reducing recidivism is to identify the risk factors that are associated with their specific type offending behaviour.

The overall aim for risk assessment tools is to understand the likelihood of an offender committing a new offence and what needs to be done to reduce that type of likelihood (Bonta, 1999). To address this aim, professionals require a series of risk factors to guide their responses, these factors may include static risk factors, dynamic risk factors, protective risk factors or contextual risk factors, these will be discussed in the following topics.

The "What Works" literature (Blackburn, 1980) saw the introduction of the Scientist/Practitioner model for practical application within the criminal justice system. This resulted in further work being conducted on offender recidivism (Andrews, 2001; Gendreau, Little, Goggin, 1996; Hollin, 1999). With this came the need to address offenders and rehabilitation, as this need became more apparent, the fluid nature of offender risk emerged and the identification of risk factors played a crucial role for practitioners and clinicians. The

term dangerousness is used in the judicial system to provide evidence and support sentencing and court disposal decisions. As a result, the risk assessment process went through an evolution to best reflect a more fluid process of risk assessment commencing in the 1950's and developing over the decades to present day. Offender risk assessments and its specific focus has changed over the decades. The different approaches to risk assessments are described as following a generational path beginning with the most basic form of risk assessment, the first-generation risk assessments, to the latest approaches to risk assessment, the fourth-generation risk assessments. This approach to risk assessment was originally defined and popularised by Bonta (1996). We will now discuss the four generations of risk assessments and provide examples as we progress and evolve throughout the generations.

First-Generation Risk Assessments

First generation risk assessments commenced around the 1950's and represents the earliest attempts to establish and make decisions on an individual's level of risk based on professional judgements. According to Bonta's (1996) terminology, the first-generation risk assessments are those tools which are based on unaided and unstructured clinical judgements (Andrews & Bonta, 2003; Dawes, Faust, & Meehl, 1989). While this approach has been commended for its person centeredness and flexibility there is a high degree of variability between clinicians (Johnstone, 2013). One of the key features of this type of approach is that practitioner's decisions are somewhat subjective and are sometimes guided by "gut feelings" which are not empirically validated or tested (Andrews & Bonta, 2003) and lacked predictive validity (Quinsey, Harris, Rice & Cormier, 1998). These risk assessments created issues of transparency and bias between clinicians and practitioners in the field (Hastie & Dawes, 2010; Holzworth, 2001).

Based on good practice guidelines, the Department of Health, National Risk Management Programme (2007) discourage the use of unstructured clinical judgements in risk assessments. Overall, this type of approach is non-actuarial and over reliant on professional judgements alone which provides minimal justification when making decisions on an individual's level of risk. We will see throughout this topic that first generation risk assessments have been largely replaced by more reliable, accurate and justifiable actuarial approaches with the evolution of second, third and fourth generation risk assessments.

Second-Generation Risk Assessments

Since the evolution of first-generation risk assessments, a second wave of risk assessments emerged, the introduction of static risk factors for actuarial risk assessments. The 1970's saw risk assessments take form of more evidence-based approaches (Andrews & Bonta, 2003). By this, actuarial risk assessment tools aligned towards empirical-based research focussing on statistical relationships between static offence history variables and its likelihood of future re-offending (Kim et al., 2008). It was identified that empirically based risk factors provide reasonably strong predictive accuracy than professional judgements alone (Andrews, Bonta, & Wormith, 2006; Hilton, Harris & Rice, 2006). Also, second-generation actuarial risk prediction tools consistently outperform practitioner's unaided clinical judgments (Quinsey et al., 2006a; Moran, Sweda, Fragala, & Sasscer-Burgos, 2001; Harris, Rice, & Quinsey, 1993; Silver et al., 2000; Carroll, Wiener, Coates, Galegher, & Alibrio, 1982).

These structured risk assessment methods otherwise known as actuarial prediction measures generally comprise of multiple risk factors which are then assigned a numerical weight which

are combined into a risk scale to provide an overall total score. Higher scores indicating higher risk and lower scores indicating lower risk for reoffending. Thus, these risk assessments are algorithmic and mathematically determined when applying the actuarial approach (Davis & Ogloff, 2008; Quinsey et al., 2006a). Second generation methods are based on an actuarial approach that predominantly relies on the use of static risk factors to predict recidivism (Kim et al., 2008). Static risk factors are described as unchangeable historical factors that cannot be changed throughout an individual's lifetime but offer no guidance in the reduction of future risk (Jones, Brown, & Zamble, 2010). Static risk factors include prior criminal history, demographics such as age, ethnicity, gender, court outcomes and length of sentence. Static risk factors may also include the environment and upbringing in which the individual was raised, such as the immediate family environment or society (Wyatt, 2018). Static risk factors may also include biological predispositions such as deficits in monoamine oxidase (Brunner, Nelen, Breakefield, Ropers & van Oost, 1993), high levels of dopamine (Morley & Hall, 2003) and low levels of serotonin (Morley & Hall, 2003; Lowenstein, 2003).

Although, making risk management decisions purely on static risk factors alone have been heavily criticized (Campbell, French, & Gendreau, 2009; Dolan & Doyle, 2000; Harcourt, 2006). This is due to actuarial tools providing little information on why an offender commits future offences and what needs to be done to reduce that risk of reoffending. Further, static risk factors do not consider the fluid psychological changes within the individual (Wyatt, 2018). Others have criticised this approach for not including important clinical information as part of the risk assessment process, all of which support the development of treatment plans (Hart, 1998). These shortcomings of excluding clinical and dynamic risk factors are addressed and incorporated in third generation approaches.

Rice and Harris (1996) developed a multivariate equation to predict recidivism for mentally disordered firesetters. This included variables such as age at first firesetting offence and prior firesetting histories. Their findings are consistent with the earlier literature on arson recidivism and provide a good starting point for the development of risk prediction tools for arsonists (Rice & Harris, 1996). This goal complements the work conducted by Geller (1992) who reinforced the need for the development of risk prediction tools for firesetters. To date, Edwards and Grace (2014) are the only published researchers that have developed an operationalised second-generation actuarial tool for arson recidivism. This published empirical piece of work forms chapter two of the thesis.

Actuarial risk assessment tools are widely used operationally and there are different types of actuarial risk assessments with some having more benefits than others. We will now briefly discuss several second-generation risk instruments primarily for violent and general offenders.

Statistical Information on Recidivism (SIR)

A popular Canadian-developed second-generation instrument for general recidivism is the Statistical Information on Recidivism (SIR) scale by Nuffield (1982). Bonta, Harman, Hann, and Cormier (1996) conducted a re-validation study of the SIR scale and their findings suggest that the SIR scale is a good predictor for general recidivism. The SIR scale provides a quick and practical method for assessing offender risk levels that are reasonably comparable with other risk assessment instruments (Bonta et al., 1996). This tool assists in the decision-making for release, security and supervision classification of offenders (Andrews & Bonta,

2003). Although, it must be stressed that the SIR was built on Canadian data and is only relevant for use in the Canadian context, therefore a great deal of caution is advised when applying the SIR to jurisdictions outside Canada.

Offender Group Reconviction Scale (OGRS v.3)

A UK-developed second-generation actuarial instrument that predicts general recidivism is the revised Offender Group Reconviction Scale (OGRS v.3; Howard, Francis, Soothill, & Humphreys, 2009). The OGRS v.3 like its previous two versions are actuarial scales based on static risk factors; such as age, gender and prior criminal history (Howard et al., 2009). This scale was implemented in 2008 and since its inception has been widely accepted and used in the prison setting and probationary/youth justice sectors across England and Wales (Howard et al., 2009). The OGRS v.3 is the newest version of the OGRS v.2 and identifies key predictors for general recidivism (Howard et al., 2009). It is also stressed that the OGRS scales were built on UK data therefore relevant for use in the UK, caution is recommended when applying the OGRS scale to jurisdictions outside the UK.

However, this scale has minimal utility on specific types of offenders who commit sexual or arson crimes and even less use for violent offenders. There are well established and valid offender risk instruments that are suitable for violent and sexual offender types, such as the OASys Violent Predictor (OVP; Howard & Dixon, 2012), the Violent Risk Appraisal Guide (VRAG; Quinsey et al., 2006a) and for the violent and for the non-violent offender, the Risk Matrix 2000 (RM2000; Thornton, 2007). Examples of pure actuarial risk assessment scales include the STATIC-99 (Hanson & Thornton, 2000) and the Sex Offender Risk Appraisal Guide (SORAG; Quinsey et al., 2006a). These two scales are based on classifying risk factors

and characteristics from each offender group to identify the most predictive risk factors associated with violent and sexual re-offending (Palk, Freeman, & Davey, 2008). Some of these risk instruments (VRAG and STATIC-99) have been developed using highly sophisticated psychometric methods and are based on non-theoretical perspectives (Campbell et al., 2007). Unfortunately, like most actuarial risk assessments fail to contribute to the planning of effective intervention and offender treatment plans (Bonta & Andrews, 2007). Now that we have discussed several popular actuarial risk assessment tools developed in Canada and the UK, we will now direct our attention to one of NZ's most preferred actuarial risk assessment tools, the RoC*RoI (Bakker et al., 1999).

The Risk of re-Conviction and Risk of re-Imprisonment (RoC*RoI)

A second-generation actuarial static risk tool developed in NZ is the RoC*RoI model (Bakker et al., 1999). This model was primarily designed for the NZ Department of Corrections to assist in predicting future general criminal offending (Bakker et al., 1999). Since its emergence in 2001, the RoC*RoI has been the primary recidivism measure of choice for assessing every NZ offender in custody. This static risk assessment tool relies on a sophisticated computerised risk measurement procedure that identifies both the likelihood that an individual will be re-convicted in the future and also provide an indication of the seriousness of their re-reoffending leading to imprisonment (Bakker et al., 1999). Thus, the RoC*RoI is a combination of two operating risk models, RoC equals Risk of re-Conviction and RoI equals the Risk of re-Imprisonment. These two risk models derive from the mathematical relationships on static risk predictors obtained from a NZ Government database which captures criminal history information, time in custody, social and demographic data such as age and gender (Bakker et al., 1999).

The RoC*RoI weighs on 16 static risk factors according to their relationship with re-offending. The complete criminal histories of more than 133,000 convicted and imprisonable NZ offenders (1983, 1988, 1989 and for any future offending over a five-year period) were used to develop the RoC*RoI (Bakker et al., 1999). The developers relied on logistic regression to identify any relationships between the predictor variables and future criminal offending (Bakker et al., 1999). The large sample size allowed the developers to validate the RoC*RoI model by splitting the sample into developmental and validation subsamples (Bakker et al., 1999). The overall predictive accuracy of the RoC*RoI measure provided an Area Under of the Curve (AUC) of .76. This finding indicates a high level of predictive accuracy (Bakker et al., 1999) and has since been replicated in other studies (Nadesu, 2007).

To assess an individual's risk score, the RoC*RoI calculates the statistical probability of re-offending, which ranges from 0.0 to 1.0, this representing 0% risk to 100% risk of serious recidivism. This reflects the likelihood of an individual committing a subsequent offence that attracts a prison sentence within a five-year period (Bakker et al., 1999). For example, a score on the RoC*RoI measure of 0.7 would indicate that the individual would have a 70% likelihood of being imprisoned within the next five years and would be classified as high-risk. In contrast, a RoC*RoI score of 0.3 or below would indicate a low-risk individual with a 30% chance of being sent to prison (Bakker et al., 1999). Alternatively, a medium-risk individual would have a score between 0.3 and 0.7 (Bakker et al., 1999). The NZ Department of Corrections rely on the risk scores to assist with sentence management decisions and prioritizing key rehabilitative services (Bakker et al., 1999). By this, individuals identified as high-risk would receive more intensive rehabilitation compared to an individual classified as low-risk (Bakker et al., 1999).

Although, it must be acknowledged that the RoC*RoI measure has produced several inconsistent results particularly for child sex offenders and youth recidivists. Many convicted child sex offenders and youth offenders have provided low RoC*RoI scores (Bakker et al., 1999). This reflects that sex offending is a specialist form of offending that may occur with low frequencies and in some cases occur with long gaps between each sex offence (Bakker et al., 1999). Sex offences against children may also go undetected for long and extended periods of time due to the nature of the offences and some historical crimes may take years or decades to be reported (Bakker et al., 1999). Also, sex offences against children are not necessarily correlated with other forms of criminal offending. In order for the RoC*RoI to be fully effective it must rely on previous recorded offences to estimate the probability of reoffending and to identify predicted risk levels (Bakker et al., 1999).

For youth offenders, it is questioned whether a static tool designed to predict reimprisonment (Roc*RoI) is relevant for youth assessment (Bakker et al., 1999). It is suggested that on-going risk factors are more relevant for assessing youth reconviction (such as the DRAOR) compared to one-time single risk-assessments that are based primarily on criminal histories (RoC*RoI). Thus, the RoC*RoI scores are not generated as frequently and are regularly updated compared to DRAOR scores (Bakker et al., 1999). Based on these limitations, a great deal of caution must be stressed when applying the RoC*RoI for sex offenders, youth offenders and other specialist type of offenders such as arson offenders. This is not a limitation of the RoC*RoI model given that it was not designed specifically for these types of crimes and unique types of offenders. The utility and generalizability of the RoC*RoI model can only be assessed against the goal for which the model was originally designed for.

Given that the RoC*RoI model is one of the most relevant NZ measures for this thesis, it is important to discuss any relationships between the RoC*RoI and the Edwards and Grace (2014) actuarial model proposed in this thesis (see chapter 2). Currently, the RoC*RoI risk tool is adopted by the NZ Department of Corrections as its primary actuarial risk assessment measure for all NZ offenders held in corrective custody (Bakker et al., 1999). This is due in part to the tool invariably outperforming clinical and experienced correctional officers when making predictions about future general criminal offending (Bakker et al., 1999).

The RoC*RoI addresses two of the key research questions in this thesis; first, whether actuarial tools can be created to predict rare offending events such as arson. Since the RoC*RoI's inception as an actuarial tool in 2001, it has been used extensively in NZ for conducting risk assessments and making predictions for all types of convicted offenders. This includes predicting and assessing rare offending events such as arson. This supports the first research question that actuarial tools can be created to predict rare offending events such as arson offending, although caution is stressed when utilizing the RoC*RoI for specialist types of offenders (such as arsonists). Currently, the RoC*RoI is the preferred measure of choice for convicted arson offenders in NZ and no other arson actuarial tools have been formally endorsed and utilized by the NZ Department of Corrections. Developing such a specialist type of tool (see Edwards & Grace, 2014) would greatly enhance the validity, reliability and justification of actuarial tools for predicting rare offending events such as arson.

The second research question in this thesis which neatly fits in this topic, is how can actuarial tools be used and who would benefit from using them? Similar to the RoC*RoI model, the Edwards and Grace (2014) actuarial model provides scientific empirical evidence to support offender management decisions in the corrective setting. This includes classification,

supervision and guiding clinical decision-making processes for appropriate treatment allocation, intensity, intervention and rehabilitation. It is proposed that the Edwards and Grace (2014) model would greatly assist the NZ Department of Corrections if merged with IOMS or the RoC*RoI model. In collaborating the models, we promote transparency, strengthen firm defensible and justified recommendations for senior management decision-making processes, support ethical and legal issues (upholding the rights and liberties of those convicted for arson) and aide third and fourth generation approaches to arson risk assessment.

Overall, if both NZ developed actuarial tools, the RoC*RoI model and the Edwards and Grace (2014) model were to be combined into a hybrid model it would provide practitioners, clinicians and corrections staff with the best possible model to accurately identifying and best manage high-risk individuals who have the proclivity and propensity for committing arson and firesetting offences in the future. In the next section (arson risk assessment) we will further discuss relationships and key differences between the RoC*RoI model and the Edwards and Grace (2014) model.

Third-Generation Risk Assessments

The next progressive stage of risk assessments are the third-generation risk assessments, often referred to as "risk-needs" assessment instruments. These next level instruments took form in the 1990's and are regarded as the more elaborate and structured methods of actuarial risk assessments combing static and dynamic risk factors in their risk assessments. Although static risk factors are useful for predicting the overall risk of recidivism in the long term, these risk factors provide minimal guidance for appropriate treatment needs for offenders. By combining the use of static and dynamic risk factors we increase the predictive validity of

these tools (Gendreau et al., 1996) and we best serve towards identifying appropriate targets (criminogenic needs) for risk assessment and offender management. Further, Hanson et al., (2007) identified that risk assessments with the highest predictive accuracies were those tools that combined both static and dynamic risk factors.

To reduce the risk of recidivism, appropriate treatment should be aimed at specific dynamic risk factors which are known to predict re-offending and can be changed or modified by treatment and intervention (Andrews, 1990). The presence of a dynamic risk factor informs practitioners what should be treated to reduce the offender's risk. This assists practitioners in identifying specific targets for behaviour change, appropriate intervention and treatment (Benda, Corwyn, & Toombs, 2001). Dynamic risk factors or criminogenic needs are factors within the individual which are changeable and can be modified such as; criminal associates, alcohol and drug use (Benda et al., 2001). It is these risk factors that enable practitioners to measure any fluctuating levels of risk over a period of time (Beech & Ward, 2004). Traditionally, dynamic risk factors may include more broad situational variables which extend beyond intra-personal risk factors. Dynamic risk factors may further be categorised as stable or acute risk factors, such as; stable risk factors reflecting longer standing predictor variables (personality traits) and acute risk factors reflecting transient dependable variables such as drug use (Hanson, 1998).

In sum, second-generation risk assessments are primarily based on static and actuarial designs, whereas third-generation models are based on a combination of both static and dynamic actuarial models. Thus, third generation tools incorporate dynamic variables but are still actuarial rather than case specific and individualised (fourth generation approaches). We

will now discuss several operationalised third-generation tools (LSI-R and HCR-20) and conclude this section by reviewing promising firesetting risk assessment tools.

Level of Service Inventory-Revised (LSI-R)

An example of a third-generation instrument developed by Andrews and Bonta (1995) is the Level of Service Inventory-Revised (LSI-R). The LSI-R instrument consists of 54- items which assesses 10 areas of risk, these risk factors include; personal problems, substance abuse and prior criminal histories (Benda et al., 2001; Loza & Loza-Fanous, 1999). The total scores obtained from the LSI-R assessments are further classified into various risk levels that reflect various probabilities of recidivism (Benda et al., 2001). In support of the LSI-R tool, Gendreau et al., (1996) conducted a meta-analysis and concluded that the LSI-R is one of the most useful actuarial measures of choice for predicting general reoffending (Campbell et al., 2009).

HCR-20 (v.3)

More specifically, a third-generation tool for assessing violent risk is the HCR-20 (Douglas, Hart, Webster, & Belfrage, 2013). The HCR-20 has been proposed as a useful measure for assessing the risk of arson recidivism for those firesetting behaviours that are deemed to be violent (Gannon & Pina, 2010). The HCR-20 v.3 guidelines proposed by Douglas et al., (2013) defines the act of violence as; a person engaged in an act or omission, with a degree of wilfulness, and cause or potential to cause physical or serious psychological harm, to another person (Douglas et al., 2013). Based on these elements, certain acts of arson may meet the definition of violence; that is certain firesetting acts with the intent of harming others, may be

appropriate cases for the HCR-20 v.3 (Gannon & Pina, 2010). Although, some researchers have suggested there is much doubt in administering conventional violent risk assessment tools (such as the HCR-20) for arson offenders (Doley et al., 2011). Further, there is no empirical evidence that has examined the predictive validity and utility of the HCR-20 for mentally disordered firesetters. In addition, research indicates that firesetting is not always motivated by violence (Jayaraman & Frazer, 2006; Butler & Gannon, 2015; Rix, 1994). This discussion forms one of the key research questions in this thesis of whether arson offenders can be distinguished from other types of offenders (see chapters 2 and 3). We will now direct our attention towards promising and developing firesetting risk assessment tools in the field.

Promising Firesetting Risk Assessment Tools

Currently, there are several promising and developing fire-specific risk assessment tools in the field (Burton et al., 2012; Quinsey, et al., 2006a). Some of which fit within the category of third-generation risk assessments which have been developed based on empirical and theoretical literature relating to firesetting. Other tools discussed provide particularly valuable information on how to assess, manage and treat firesetters uniquely within their respective clinical, forensic, or correctional settings. We will briefly describe a series of arson-specific tools, their development, content and their operational utility and generalisability as a tool for arson offenders and firesetters.

The St Andrews Fire and Arson Risk Instrument (SAFARI)

The SAFARI by Long, Banyard, Fulton, and Hollin (2014) and was developed based on a small group of mentally disordered female patients (n = 15) who were detained under the Mental Health Act 1983 at the Women's Service of St Andrew's Healthcare, Northampton,

UK. The development of this instrument was driven by the absence of valid and reliable firesetting assessment tools for mentally disordered populations in the UK (Long et al., 2014). The SAFRAI was also designed to argument and supplement the HCR-20 (Webster et al., 1997) and to support a wider formulation of risk based on firesetting behaviours. The overall purpose of the SAFARI is to provide an understanding of the various factors contributing to firesetting behaviour that may assist in case formulation and treatment (Long et al., 2014).

The authors relied on the limited literature available to help design and structure specific interview questions. This included open ended and closed questions relating to background behaviour (developmental), cognitive (emotional), environmental and specific triggering events (Long et al., 2014). These unique questions led to a semi-structured interview that examined the interplay between antecedents, behaviours and consequences (ABC) which are associated with firesetting behaviour (Long et al., 2014). Overall, the SAFARI attempts to guide and tailor individual treatment programmes using cognitive behavioural treatment (CBT) approaches to address identified targets for change. This approach is aligned to Jackson et al.'s (1987) functional analysis for the firesetting assessment (Long et al., 2014).

Although, the SAFARI shows great promise as an assessment tool it also has several limitations. That is, the SAFARI primarily focuses on treatment targets with less emphasis on actual arson risk assessment (Long et al., 2014). Thus, the SAFARI is not a risk assessment tool in its true form and provides no real risk management solutions (Wyatt, 2018). The tool is inherently stuck with the unreliability of self-reporting in a forensic setting and the tool does not provide a complete understanding of static and dynamic risk factors. Last, there is

the need to verify the tools reliability and validity across the wider population of firesetters across different settings and to include male firesetters (Long et al., 2014).

The Northgate Firesetter Risk Assessment (NFRA)

The NFRA was developed by Taylor and Thorne (2005) and comprised of a group of intellectually disabled adult firesetters in the UK. The authors propose a risk assessment measure and assessment scheme for organising sources of information. It is intended that this tool will assist forensic practitioners and professionals in understanding the risks and clinical needs of those firesetters with intellectual disabilities (Taylor & Thorne, 2005). Further, this work may provide a functional analytic framework to assist with the assessment and case formulation for firesetting behaviour (Taylor & Thorne, 2005).

As portrayed by Gannon and Pina (2010) there is limited literature available on firesetting risk factors. What we do know is that several actuarial risk factors such as; history of fire setting and the number of fires set have shown promise for predicting firesetting recidivism with mentally disordered offenders (Rice & Harris, 1996). Similarly, Dickens et al., (2009) identified from their study that firesetting recidivism is associated with young age, single, early onset for criminality, property-type offending, history of substance abuse, violence and relationship issues.

Taylor and Thorne (2005) extended beyond these historical and actuarial risk factors and incorporate information from a wide range of risk factors and clinical issues. The NFRA is based on the Historical Clinical Risk Management-20 (HCR-20 v.3) structure and consists of five historical static factors and six dynamic risk/clinical items (Taylor & Thorne, 2005). For

example, items H1 to H4 refer to a history of fire setting/level of fire interest and item H5 refers to dispositional setting conditions (Taylor & Thorne, 2005).

The NFRA has been recently expanded to a revised version 2.0. This revised assessment measure incorporates the many risk factors associated with the risk of firesetting and each historical and clinical item is scored and a final risk judgement is made based on the overall score (Taylor & Thorne, 2019). This updated assessment comprises of 10 historical risk factors and 10 clinical risk items, for the 10 historical risk factors these include; pre-16 years previous firesetting (H1) and previous adult firesetting (H2), previous targeted firesetting (H3), false/hoax alarms (H4), previous self-harm and suicide attempts (H5), absence of interpersonal violence (H6), personality disorder (H7), revenge motive (H8), history of child abuse/neglect (H9) and substance abuse (FH10) (Taylor & Thorne, 2019). For the 10 clinical risk items these include recent depression/stress (C1), high anger levels (C2), social ineffectiveness (C3), impulsivity (C4), major mental illness using DSM/ICD criteria (C5), low social attention/feelings (C6), low self-esteem (C7), fascination with fires (C8), impoverished social networks (C9) and male gender (C10) (Taylor & Thorne, 2019).

These clinical items are consistent with the limited literature on pathological firesetter characteristics and recidivism (Taylor & Thorne, 2019). A limitation with this tool is that the NFRA was developed on a group of intellectually disabled adult firesetters in the UK. Similar, to the SAFARI there is the need to test this tools reliability and validity across the wider population of firesetters and across different settings and jurisdictions.

Pathological Firesetters Interview (PFSI)

Prior to the NFRA, Taylor, Thorne, and Slavkin, (2004) developed the Pathological Fire Setters Interview (PFSI). This is a structured interview process based on patient records, staff observations, informant and a variety of patient clinical measures and risk assessments to formulate risk, need and management plans for the firesetter (Taylor et al., 2004; Taylor & Thorne, 2019). Similar, to the NFRA, the PFSI is designed on the functional analytic framework which is theoretically driven. The PFSI comprises of several components as part of its underlying framework and collection of information, this includes demographics, personal and previous offending history, situational settings (abuse, care and education), dispositional settings (psychological), immediate antecedents (drug and alcohol use), offence specific factors (motives) and consequences of firesetting (relief) (Taylor et al., 2004).

The rationale for incorporating information from several different sources is that it will assist with formulating an overall risk and intervention management plan for firesetters (Watt & Ong, 2016). Overall, the PFSI may be used as a framework to provide information that may assist in analysing firesetter behaviour. Similar to the NFRA, the PFSI has only been used in case studies and is yet to be evaluated and tested for its reliability and validity (Davies & Beech, 2012).

Further, various risk factors, fire-specific and clinical assessment tools are used by Taylor et al., (2004) to provide information for the analysis of firesetter behaviour. This includes the Goal Attainment Scales (GAS; Kiresuk & Sherman, 1968) to support clinical evaluations and group therapy intervention for firesetters with intellectual disabilities (Taylor et al., 2002). Based on the answers provided in a semi-structured interview, the group therapist and an

independent assessor scores the individual based on six offence-related treatment targets (Taylor et al., 2002). Next the assessor uses a five-point scale using an operationalised scoring criteria based on scores that indicate high or low risk levels for firesetting (Taylor et al., 2002). The authors suggest that the GAS may be incorporated into a functional analytic framework.

Further, Taylor et al., (2002) investigated other reliable and valid clinical assessment measures associated with firesetting behaviour and mental health. This includes the Beck Depression Inventory Short Form (BDI; Beck & Beck, 1972). The inventory is a 13-item brief self-report measure to assess depression with each BDI item being rated on a 4-point scale that relates to signs and symptoms of depression. Taylor et al., (2002) used this established measure against a group of firesetters with mid-borderline intellectual disabilities. Also, Novaco and Taylor (2004) assessed anger and self-esteem using the Novaco Anger Scale (NAS; Novaco, 2003), which is a 48-item self-report measure modified for use with adults with intellectual disabilities (Novaco & Taylor, 2004). For social effectiveness, Taylor et al., (2019) used the Culture Free Self-Esteem Inventory – 2nd Edition, Form AD (CFSEI-2; Battle, 1992). This inventory is regarded as a reliable 40-item self-report inventory to measure self-esteem (Taylor & Thorne, 2019). The 40-items are summed to provide a total index score to indicate the level of social effectiveness (Taylor & Thorne, 2019).

It is suggested by Taylor et al., (2002) that using these established clinical measures in conjunction with fire specific measures may provide an evidence-based approach for forensic practitioners (Taylor & Thorne, 2019). By that, these inventories will support practitioner's ratings for the risk assessment items relating to depression, anger, and social effectiveness. This may formulate the treatment needs and responsivity issues surrounding the individuals

learning abilities (Taylor & Thorne, 2019). Taylor et al., (2002) recommend that forensic practitioners do consider three distinct but overlapping areas of assessment with firesetters, these are; first, specific firesetter risk factors, second, specific firesetter risk assessments and third, relevant clinical factors (such as depression, anxiety and self-esteem) (Taylor & Thorne, 2019).

The Fire Interest Rating Scale (FIRS)

Murphy and Clare (1996) developed a fire-specific self-reporting inventory based on a small group of intellectually disabled UK adults in a routine clinical setting. The FIRS consist of a 14-item scale used to obtain an individual's interest in fire-related situations or scenarios and assess how the individual feels in each fire-related scenario (Murphy & Clare, 1996). The individual is asked to rate how they feel during the 14 descriptions of fire-related situations using a 1 to 7-point scale. For the scale, 1 implies they view the fire as most upsetting or horrible, 4 implies the fire does not bother them and 7 implies the fire is exciting (Murphy & Clare, 1996). The information obtained from the scale assists in understanding firesetting motivation and whether fire interest has contributed to the offence (Murphy & Clare, 1996). This assists with identifying specific treatment targets for intellectually disabled adult firesetters. A limitation of the FIRS is that it has not been subjected to any psychometric evaluations and is yet to be published (Murphy & Clare, 1996). Also, the validity and reliability of the FIRS is yet to be scrutinised (Curtis, McVilly, & Day, 2012).

The Firesetting Assessment Schedule (FASch)

Around the same time, Murphy and Clare (1996) developed the 32-statement structured interview; the Firesetting Assessment Schedule (FASch) for firesetters. This schedule was also based on a small group of adult firesetters from the UK with mild learning disabilities and major behavioural disorders. The first 16-items of the FASch relates to cognitions and feelings prior to setting the fire and the second 16-items relates to the individual's thoughts and feelings after the fire (Murphy & Clare, 1996). At the conclusion of the interview, the clinician is provided with ratings for motivation and consequences. This indicates the degree of which their fire was related to certain aspects such as; self-stimulation, anxiety, social attention, depression and anger (Murphy & Clare, 1996).

The FASch adopted the functional analytical approach to firesetting and suggests that firesetting is associated with various psychological functions such as; the need to express sadness, retribution and reduce anxiety levels (Murphy & Clare, 1996; Taylor & Thorne, 2019). The most frequently endorsed FASch antecedent items and motivations for firesetting by adults with intellectual disabilities were anger, being ignored and depression (Murphy & Clare, 1996; Taylor et al., 2002).

However, it was difficult for an individual to identify how they felt after the fire. This highlights the difficulties that this group may experience when processing and reflecting their thoughts and feelings after they started a fire (Murphy & Clare, 1996). This schedule can be used as a firesetter assessment tool specifically for adults with mild and borderline intellectually disabilities and those with relatively good verbal skills (Murphy & Clare, 1996).

Limitations for the FIRS and FASch are acknowledged by the authors in which both are developed from routine clinical settings and are yet to undergo rigorous psychometric evaluations (Murphy & Clare, 1996; Taylor & Thorne, 2019). Further, both assessments are developed from a small group of intellectually disabled UK adult firesetters and the tools are primarily designed for this specific group of firesetters. One of the major unresolved issues with these scales is whether the individual's reports are valid or not. That is, individual's beliefs to reason their behaviour may not be the same as their actual real causes for their behaviour. Participating individuals were not free to assert any reasons for their fires given that the interviews were designed in a way to tap into their motives. The authors do note that it is important to provide further validation for these individual reports. However, the FIRS and FASch may be administered as part of a comprehensive assessment tool in conjunction with the PFSI framework for groups of intellectually disabled adults in a clinical setting (Taylor & Thorne, 2019).

The Firesetting Risk Assessment Tool for Youth (FRAT-Y)

The FRAT-Y was developed by Stadolnik (2010) and is described as a third-generation risk assessment tool which combines scientific and actuarial risk prediction measures for children and adolescents. The FRAT-Y relies on clinical risk assessments that are based on a variety of methods using multiple measures to provide the practitioner with a firesetting assessment framework that is grounded on exiting literature and research evidence (Stadolnik, 2010). The author suggests that this type of structured decision-making tool improves clinical decision-making processes relating to global firesetting risk, supporting organization and structuring of firesetting risk assessment tools and guiding assessment practices to determine the most appropriate intervention plan for each child (Stadolnik, 2010).

The FRAT-Y was appropriately designed for children and adolescents between the ages of 5-years to 17-years and examines several critical domains, including 17 research-based risk factors associated with firesetting (Stadolnik, 2010). Next, the FRAT-Y offers 13 descriptive profiles that assist in identifying a youth's motivation for firesetting. Last, the FRAT-Y develops risk profiles and detects the presence or absence and severity of risk factors among juveniles (Stadolnik, 2010). Once this information has been obtained and collated from the individual a rating on each of the 17-risk factors (see professional manual of the FRAT-Y) is completed by a mental health clinician (Stadolnik, 2010).

The clinical ratings are evaluated and supported by specific criteria for each risk factor which are entered on a rating form. The individual ratings are transferred to the FRAT-Y risk profile form so that the clinician may first, estimate an overall risk assessment, and second, indicate primary and/or secondary firesetting motivations based on 13 motivations prescribed in the manual (Stadolnik, 2010). Once the comprehensive firesetting behaviour risk assessment is completed, risk profiles and specific intervention addressing the needs for each child and family is proposed (Stadolnik, 2010).

Overall, since its publication in 2010, the FRAT-Y has provided a framework to formulate firesetting risk for reoffending and support structured decision-making to guide the most appropriate intervention and treatment planning for each child (Stadolnik, 2010). However, the diagnostic and prognostic reliability and validity of the FRAT-Y is limited. Stadolnik (2010) suggests that research over the last 20-years has revealed that youth firesetting recidivism rates decrease when they receive fire specific and multi-disciplinary interventions.

The Fire Setting Scale (FSS) and Fire Proclivity Scale (FPS)

Gannon and Barrowcliffe (2012) conducted research that examined self-reporting of deliberate firesetting in the UK. Their main goal was to develop two new scales, the FSS and the FPS, with the aim of exploring their psychometric properties. Second, the authors wanted to examine the prevalence and characteristics of deliberate firesetting, third, identify developmental factors associated with firesetting and last, classify non-apprehended individuals as firesetters from non-firesetters (Gannon & Barrowcliffe, 2012). Their study was based on an initial 158 participants (49 male and 109 females) of which n = 150 returned about two weeks later to complete the same measures again. Of the initial sample, n = 18 (11.4%) self-reported setting a deliberate fire and that these participants were similar to non-firesetters on basic demographics (Gannon & Barrowcliffe, 2012). Interestingly, these firesetters reported more behavioural problems and having previous convictions for vandalism-related offences compared to non-firesetters (Gannon & Barrowcliffe, 2012). Further, their findings support the literature that known firesetters possess antisocial traits (Becker et al., 2004; Lindberg et al., 2005; Repo & Virkkunen, 1997).

The Fire Setting Scale (FSS) measure is a conventional 20-item self-report questionnaire which is based on empirical literature highlighting factors related to adolescent and adult firesetters (Gannon & Pina, 2010). The final 20-item scale contains two 10-item subscales that measure two constructs, firstly, antisocial behaviour items relating to firesetting such as "I like to engage in acts that are dangerous". Secondly, general fire interest items such as "I get exciting thinking about fire" (Gannon & Barrowcliffe, 2012). The items within the scale are randomised and not split into the two distinct sections (antisocial behaviour and fire

interest). The items from both subscales are scored on a seven-point Likert scale ranging from 1 (not at all like me) to 7 (very strongly like me) (Gannon & Barrowcliffe, 2012).

The Fire Proclivity Scale (FPS) measure is based on a similar format to the Bohner's et al., (1998) Rape Proclivity Scale. The FPS was designed to tap into an individual's propensity to engage in firesetting and consists of six hypothetical situations of firesetting. For each situation, individuals were asked to imagine themselves in that situation and answer four questions about themselves using a 5-point Likert scale ranging from 1 (would not enjoy it at all) to 5 (would greatly enjoy it) (Gannon & Barrowcliffe, 2012). For all six situations, it is possible to calculate an overall fire propensity score, fire fascination score, fire behavioural propensity score, fire arousal score and a fire antisocialism score.

In the social-psychological literature, proclivity scales have advanced the understanding of rape and sexual harassment crimes (Bohner et al., 1998; Pryor, 1987). Thus, the aim of the FPS is to advance the understanding of firesetters by measuring their proclivity to set fires. A second aim is to examine the scales ability to differentiate between self-reported firesetters and non-firesetters in the UK community. The findings from their study suggests that firesetting proclivity represents a valid indicator of actual firesetting behaviour. Although, the authors do stress that these findings are provisional and future validation is highly recommended using larger community samples.

Overall, both scales (FSS and FPS) produced promising psychometric properties, internal consistency, excellent test-retest reliabilities, discriminated between self-reported firesetters vs non-firesetters and showed great promise for identifying factors associated with firesetting (Gannon & Barrowcliffe, 2012). This work may be useful in detecting individuals within the

UK community who require firesetting prevention particularly in secure and controlled environments (Gannon & Barrowcliffe, 2012). However, the authors stress that their results require replication within the British community using a nationally representative sample so that firm conclusions may be drawn about the rates of undetected firesetters. Further, their study relied on a highly specialised and unrepresentative sample of firesetters that do not have the opportunity to set fires in the community due to their confinement in secure mental health facilities (Gannon & Pina, 2010).

The Behaviour Risk Tool (BRT)

Dadswell (2018) developed the first basic preliminary screening tool in the Australian context for young repeat firelighters. The newly developed BRT is based on a screening questionnaire that identifies young people between 5 and 17 years with psychosocial disturbances. This, in collaboration with the Juvenile Fire Awareness and Intervention Program (JFAIP) identified the need for a preliminary screening tool to identify and flag young people with psychosocial disturbances that are predictive of firesetting behaviour. The BRT was based on a sample of 61 JFAIP families which investigated fire-specific, family, and psychosocial characteristics at the time of their initial pre-intervention interview.

A 12-month follow-up was conducted to obtain information about the individuals subsequent firesetting behaviour. The authors evaluated the BRT by measuring the validity and reliability of the tool using a new sample of 63 young persons in the JFAIP at the initial pre-intervention interview phase and with a 6-month follow-up. The BRT detected 80% of the repeat firesetting and 70% of the non-repeat firesetters correctly. This suggests the tool would have failed to detect 2 out of 10 young repeat firelighters and incorrectly recommended

referrals for 1 in every 3 “at-risk” cases that were identified. However, the BRT provides empirical support for its validity and reliability in screening young repeat firelighters.

Overall, the BRT is a mixture of fire-specific and psychosocial variables which are based on 25 specific items across four instruments used to collect data, these items were based on a cohort of young people with a history of firelighting and determined the items that best predict future firelighting. The tool combines fire specific items with questions relating to externalising, internalising and social behaviours. The possible range of scores is 22-122 and if the tallied score is above the recommended authors cut off score of 57.5, the individual is deemed “at risk” for repeat firelighting. Essentially, the BRT is an early triage process tool that identifies and predicts “at risk” cases and filters those cases correctly (DiMillo, 2002). This is similar to the triage process identified by Adler, Nunn, Northam, Lebnan, and Ross (1994) which triaged youth as either pathological or non-pathological prior to intervention. The expectation from the author is that the BRT will be used as a preliminary screening tool in the JFAIP. Thus, those individuals deemed “at risk” are provided a template letter by the fire service. This letter is used to seek advice from a GP to recommend supplementary mental health services using a Medicare rebate. By this stage, such referrals, diagnoses, and treatment plans are left with the trained clinicians and mental health practitioners. It is this screening process of identifying “at-risk” cases and subsequent referrals to mental health services that the developers would expect families to engage with key service providers. It is proposed that this process may result in a reduction of future youth firelighting behaviour. The benefit of the BRT tool is that it does not require any professional expertise to conduct the initial assessment but rather only what is appropriate in the fire practitioner’s capability.

The BRT is a simple user-friendly tool which is guided by basic instructions for administering and scoring as per the BRT practitioner's instructions. Overall, the BRT is an evidence-based screening questionnaire with cut-off scores to identify young people who are deemed significantly "at-risk" for repeat firesetting. Once these cases are identified, the BRT provides an objective approach for mental health services to target individual's underlying psychological issues.

However, the limitations of the BRT include; the small sample size and limited number of females in the samples, some families did not wish to participate in the study, almost 40% of cases were not contactable at the 6-month follow-up period with some extending out to 18-months post-intervention. The authors note that the utility of the BRT outside the Australian State of Victoria and other jurisdictions is somewhat unknown, therefore the utility and generalisability of the tool for young firelighters is questionable.

The Bushfire Arson Target Screening (BATS)

The BATS was developed by Bennett, Davis, and Ogloff (2010) to assist Police investigators from the Victorian Police, Australia in collating important information for arson suspects. The BATS is based on offender risk assessment literature and provides a structured professional judgement that includes both static and dynamic risk factors. The BATS is designed to be user-friendly and may be completed on the basis that the information collated is readily available to all Victorian Police personnel (Bennett et al., 2010). Users of the BATS are advised to rank and prioritize suspects based on the number of relative BATS risk factors that they possess. The BATS risk factors comprise of seven categories of inquiry that have been obtained from the scholarly literature (Bennett et al., 2010). The seven categories are; prior arson offending and fire-lighting behaviours, general antisocial behaviour, early

maladjustment, lifestyle instability, mental health issues, known interest in fire and opportunity to light fires (Bennett et al., 2010). Each BATS risk factors are coded on a three-point ordinal scale (0 = not present; 1 = partially present; 2 = definitely present). These factors are coded according to explicit criteria in the BATS worksheet, a protected document with the Victorian Police (Bennett et al., 2014). The developers do state that the coding criteria is described in further detail in the BATS professional manual (Bennett, Davis, & Ogloff, 2014).

For the BATS instrument, there are no cut-off scores for placing a suspect into a respective risk category rather users rank and prioritise offenders based on the number of BATS risk factors they possess. Thus, individuals with higher scores on the BATS are deemed higher priority for investigation in contrast to individuals with lower scores on the BATS who would be deemed low priority for investigation (Bennett et al., 2010). This tool may be useful for prioritizing and rank-ordering suspects in unsolved or historical arson cases. Bennett et al., (2010) do state that the BATS tool appears to be a promising instrument for Police agencies and is the first of its kind in Australia.

The BATS may also be used as an arson risk assessment instrument to identify parolees who require more intensive monitoring and management attention (Bennett et al., 2010). The BATS instrument is currently unpublished and was originally prepared as an internal protected document for the Victoria Police, Australia (Bennett et al., 2010). The predictive validity of the BATS as a risk assessment tool is yet to be empirically investigated on a larger sample of arsonists in Victoria, Australia. Further, the BATS instrument has not been validated for its generalisability and utility in other jurisdictions.

Fourth-Generation Risk Assessments

We will now transition from third-generation risk assessments into fourth-generation risk assessments. This new wave of risk assessments took form in 2000 and formalises its way into practice which involves the integration of case management and third-generation approaches combined with an individualised clinical risk formulation (Hart & Logan, 2011). In doing this, clinicians may provide series of hypotheses which may help explain and understand the underlying causes and risk factors resulting in offending behaviour within the individual. This latest approach to risk assessment allows professionals to utilize risk information that is collated in a clinically useful way that can be mapped onto tailored risk management plans (Douglas, Blanchard, & Hendry, 2013) and bridging the gap between assessment and management (Lewis & Doyle, 2009). Overall, fourth generation approaches not only include risk-need assessments but also integrate the assessment process within a case management strategy.

The Youth Level of Service Case Management Inventory (YLS/CMI)

The Youth Level of Service/Case Management Inventory (YLS/CMI; Hoge & Andrews, 2001, 2002) as part of the CMI family (LS/CMI; Andrews, Bonta & Wormith, 2004) is regarded by the developers as a fourth generation tool. The YLS/CMI is a standardized case management inventory specifically designed for juvenile and youth offenders. The inventory assesses the risk factors associated with the risk of recidivism and the need factors identified for case management (Hoge, 2005). The instrument consists of 42 items that measure 8 different components of risk and needs including; prior and current offences, education,

substance abuse, family, personality behaviour, antisocial associates, leisure/recreation and attitudes/orientation (Hoge & Andrews, 2001, 2002).

Schmidt, Hoge, and Gomes (2005) suggests that the YLS/CMI provides good inter-rater reliability and predictive validity for juvenile recidivism. Although, it must be stressed that the YLS/CMI was originally developed from a sample of Canadian juvenile offenders, thus, the inventory may only be specific for use in the Canadian juvenile setting. However, the inventory has produced promising results from other ethnic groups such as Aboriginal and African American. In addition, the tool has been tested in other jurisdictions such as; the United States, United Kingdom, Singapore, Croatia and Kenya (Hoge, 2010). Further advancements of the Case Management Inventory have led to other developed inventories such the LS/CMI that incorporates responsivity factors (see RNR Model, Bonta & Andrews, 2007).

Now that we have discussed the four-generations of risk assessments, its development and evolution over the last 70-years, captured promising examples of second and third generation tools for arsonists and firesetters, we will now discuss an important influential Canadian model towards second and third-generation risk assessments, the Risk Need Responsivity Model (RNR).

The Risk Need Responsivity Model (RNR)

The RNR model is one of the most influential models which guides the assessment and treatment of offenders (Blanchette & Brown, 2006; Ward, Mesler, & Yates, 2007). The RNR model has influenced development of offender risk assessment instruments and offender

rehabilitation programs (Bonta & Andrews, 2007). The model is backed by empirical based research which demonstrates how all types of criminal behaviour can be predicted with high levels of reliability and offers practical implications for offender rehabilitation programs (Bonta & Andrews, 2007). The authors provide support that rehabilitative programs which follow the RNR model produce significant reductions in recidivism (Bonta & Andrews, 2007).

The RNR model for offender assessment and rehabilitation was originally developed in the field of criminology. Its primary purpose was to provide recommendations to practitioners on how offenders should be assessed based on their identified levels of risk, their identified needs and the best suited environment to reduce recidivism (Bonta & Andrews, 2007). The RNR was developed in the 1980's and was formalised in the 1990's and was conceptualised within the personality and cognitive social learning theory of criminal conduct (Bonta & Andrews, 2007). The model has been used to assess and rehabilitate offenders in Canada and around the world (Bonta & Andrews, 2007). The RNR model has been considered as one of the best models for assessing and determining offender treatment and some of the best offender risk assessment tools are guided on the RNR model (Bonta & Andrews, 2007).

The RNR model is based on three core principles which is used to assess offender risk, identify offender needs and guide appropriate intervention to reduce offender recidivism; the risk principle, the need principle, and the responsivity principle. In essence, the risk principle identifies who should be targeted for treated (high-risk offenders vs low-risk offenders), this best resembles second-generation tools (Bonta & Andrews, 2007). The need principle focusses on what should be treated and targeted (criminogenic needs), this best reflects third

generation tools, and the responsivity principle determines how practitioners deliver such treatment (such as CBT), this reflects third and fourth generation approaches.

The Risk Principle

It is proposed that criminal behaviour can be reliable predicted and that offenders have different levels of risk for recidivism and therefore different kinds of interventions are appropriate based on the level of risk they possess (Bonta & Andrews, 2007). That is, when the risk of recidivism is high or complex, intensive interventions are necessary and appropriate for those identified high-risk offenders. In contrast, when the risk of recidivism is low, expensive and complex interventions would not be recommended and deemed unnecessary. It is proposed that offender recidivism may be reduced if the level of treatment provided is proportionate to the offender's risk to reoffend (Bonta & Andrews, 2007).

The risk principle comprises of two components; first, the offender's risk to re-offend and second, the level of treatment required. The first part emphasizes the importance of reliably predicting criminal behaviour which requires evidence-based risk assessments (Bonta & Andrews, 2007). For this part, practitioners must ensure that they have reliable and valid approaches for classifying and determining low-risk offenders from high-risk offenders. Currently, we have recent advancements in risk assessment that make such distinctions among offenders with different probabilities of recidivism (Campbell, French & Gendreau, 2007). The risk principle best reflects second-generation tools such as the Edwards and Grace (2014) model which identifies high-risk individuals who have the propensity and proclivity for committing arson offences in the NZ context.

For the second part, this highlights the need to accurately match the level of service and treatment required to match the offender's risk to re-offend (Bonta & Andrews, 2007). By this, the higher the predicted risk-level for recidivism the higher the treatment required to reduce recidivism. Further, it is proposed that high risk offenders have more criminogenic needs than lower risk offenders and therefore additional intervention and treatment is required to address those criminogenic needs (Bonta & Andrews, 2007). Inappropriate matching and intensity of treatment services with offenders with low risk levels may result in wasted resources and in some cases may increase criminal behaviour and recidivism (see Bonta, Wallace-Capretta & Rooney, 2000). Overall, the risk principle recommends that intensive or complex treatment be reserved primarily for high-risk offenders.

The Need Principle

This principle proposes that every offender holds their own set of criminogenic needs (dynamic risk factors) that are directly associated with their criminal behaviour (Bonta & Andrews, 2007). Unlike static risk factors which are immune to treatment and intervention and can only change in one direction (increase in risk levels). It is proposed that offenders have many criminogenic needs that come and go and are subsumed under assessment referred to as the "central eight" major risk/need factors (Bonta & Andrews, 2007). These are; antisocial personality patterns, procriminal attitudes, social supports for crime, substance abuse, family/martial relationships, school/work, prosocial recreational activities and criminal history (Bonta & Andrews, 2007; Andrews et al., 2006).

Although criminal history completes the central eight list it is a static risk factor, the first seven criminogenic needs/risk factors are fundamentally important for the assessment and

targeting for effective intervention (Bonta & Andrews, 2007). It is proposed that when needs change, reoffending rates change, therefore, it is necessary that appropriate interventions that target the criminogenic needs are included in the design planning and delivery for optimal results. In terms of offender risk assessment, the need principle assesses criminogenic needs and dynamic risk factors and targets those factors in treatment. This is the hall mark of what third and fourth-generation risk instruments attempt to achieve (Bonta & Andrews, 2007).

The Responsivity Principle

This principle proposes how treatment and intervention should be provided and delivered (Bonta & Andrews, 2007). Thus, different types of intervention differ in their effectiveness for reducing recidivism. More generally, behavioural, and cognitive-behavioural treatment (CBT) are preferred. The responsivity principle maximizes the offender's ability to learn from rehabilitative intervention by providing CBT and tailoring intervention based on the learning styles, motivation, cognitive abilities and strengths of the individual (Bonta & Andrews, 2007). The responsivity principle is broken into two parts; general and specific responsivity.

General Responsivity

This is the use of cognitive social learning methods and intervention to influence new behaviours (Bonta & Andrews, 2007). These strategies are the most effective and preferred treatment methods regardless of the type of behaviour and type of offender (Bonta & Andrews, 2007). The types of cognitive social learning approaches in the correctional setting

include prosocial modelling, reinforcement/disapproval and problem solving (Dowden & Andrews, 2004).

Effective cognitive social learning approaches operate according to two principles; first, the relationship principle which is establishing respectful and collaborative rapport with the individual. Second, the structuring principle which includes; influencing prosocial behavioural change using appropriate modelling techniques, reinforcement and problem-solving strategies (Bonta & Andrews, 2007).

Specific Responsivity

This principle suggest that treatment can be enhanced if the treatment itself focusses on the personal factors that facilitate learning (Bonta & Andrews, 2007). Thus, the specific responsivity principle relates to the fine tuning of cognitive behavioural treatment (CBT) and tailored intervention to best suit the individual's personal strengths, learning style, motivation, personality factors and abilities (Bonta & Andrews, 2007). Overall, treatment should be tailored to address these factors, given that these factors have the potential to support or hinder treatment interventions (Bonta & Andrews, 2007).

Overall, by adhering to the RNR model, practitioners go beyond determining the level of risk an offender possesses (high-risk vs low-risk) but take additional steps to accept the fundamental human conditions for change by incorporating the need and responsivity principles in intervention programmes (Bonta & Andrews, 2007). Thus, when applying the risk-need-responsivity principles in offender treatment and rehabilitation programmes we see significant results in the reduction of recidivism (Bonta & Andrews, 2007).

There are broader implications of employing the RNR model and its direct relevance across a wide range of offenders. The RNR model is robust and can be applied to women offenders (Blanchette & Brown, 2006; Bonta et al., 1998), young offenders (Dowden & Andrews, 1998b), sex offenders (Hanson, 2006; Hanson & Bourgon, 2007) and indigenous such as Aboriginal offenders (Rugge, 2006). Overall, the RNR model not only contributes to the development of offender risk instruments including actuarial instruments but also provides essential information and a road map towards developing effective intervention and enhance the delivery of effective treatment (Bonta & Andrews, 2007). We will now progress from this topic and discuss several firesetting theories which help understand and explain both youth and adult firesetting behaviour.

Firesetting Theories

There are multiple psychological perspectives and different levels of firesetter theories that seek to understand and explain firesetting behaviour. These stem from single factor theories such as; the psychoanalytic theory (Sigmund Freud, 1932) and biological disorder theories to multifactorial theories. This includes functional analysis, Fineman's (1980) dynamic-behavioural model, Kolko and Kazdin's (1986) social learning model and Gannon et al., (2012) Multi-Trajectory Theory of Adult Firesetting (M-TTAF). We will now briefly discuss two proposed multifactorial models used to explain fire-lighting behaviour and conclude with a most recent multifactorial theory the M-TTAF proposed by Gannon and colleagues (2012).

Dynamic Behavioural Theory of Firesetting (DBToF)

Fineman (1980, 1995) developed one of the first proposed models for child and juvenile firesetters and incorporated psychosocial elements mixed with a review of the literature and expert observations in the field. The Dynamic-Behavioural Theory of Firesetting (DBToF) is a multifactor model that measures factors relating to fire-lighting behaviour, family and social environment, individual characteristics and life situations. It is proposed that these factors predispose a child to fire-lighting behaviours (Fineman, 1980). In essence, the model incorporates individual factors, family dynamics and their living environment, which all relate to the static, dynamic and contextual risk factors that are indicative of firesetting behaviour (Fineman, 1980). Thus, the DBToF possesses great clinical utility that may guide practitioners for appropriate intervention and behaviour change programmes specific to child's fire-lighting behaviour (Fineman, 1980).

Fineman (1995) describes juvenile firesetting as the result of the following formula: Firesetting = G1 + G2 + E, where (E = C + CF + D1 + D2 + D3 + F1 + F2 + F3 + Rex + Rin). The first part of the formula (G1) includes historical factors that predispose antisocial actions (such as social disadvantages) to juvenile firesetting behaviours, (G2) refers to previous environmental reinforcers that encourages firesetting (fascination with fires/childhood fire experiences) and (E) comprises of the current environmental reinforcers that support firesetting (Fineman, 1980). These reinforcers are broken down into several variables: (C) impulsivity triggers (rejection or trauma), (CF) crime scene characteristics (targeted attack), (D1, D2, D3) cognitions (before, during, after the firesetting episode) and (F1, F2, F3) affective states (before, during, after the firesetting episode) (Fineman, 1980). Last, (R) referring to any firesetting reinforcers, such as (Rex) external factors

(rewards/financial gain) and (Rin) internal factors (satisfaction/sensory stimulation) (Fineman, 1980).

Fineman's (1980) dynamic-behavioural multifactor model has played a crucial role in understanding firesetting behaviour and unifies contemporary firesetter knowledge to provide a logical framework and guide assessment and treatment formulation for young firesetters. However, the proposed model does have its limitations in a clinical sense. The theory primarily explains juvenile firesetters with less focus on adult firesetters, this provides a lack of explanatory depth neglecting adult firesetters. Also, the theory does not capture the full range of dynamic risk factors or criminogenic needs associated with a range of firesetting behaviour and there are no firesetter subtypes or typologies associated with firesetters included or discussed in the theory.

Social Learning Model

Next, we discuss the social learning model proposed by Kolko and Kazdin (1986). This multifactorial model incorporates three domains, with each domain made up of sub-factors that contribute to young children's fire-lighting behaviour. These are; first; the learning experiences and cues domain, which focusses on the principles of modelling and reinforcement. This includes three sub-domains: early modelling, early fire interest and adult role models (Kolko & Kazdin, 1986). Second, the personal repertoire domain, which focusses on the motivational components, cognitive elements and behavioural components of firelighting (Kolko & Kazdin, 1986). Third; the parental, family influences and stressors domain, which focusses on parenting practices, childhood upbringing and life stressors relating to firelighting behaviour (Kolko & Kazdin, 1986). This domain includes a sub-

domain of limited supervision, monitoring, parental distance and un-involvement. Parental pathology and limitations are also included in this model as with stressful external events (Kolko & Kazdin, 1986).

These described sub-domains and components have been identified as precipitating circumstances influencing firelighting behaviour (Kolko & Kazdin, 1986). Overall, this multifactorial model captures a range of domains, sub-domains and components which contribute to firelighting behaviour and helps understand child firesetter behaviour.

These two discussed multifactorial models were developed to help understand child firelighting behaviour, we will now discuss one of the most recent multifactorial theories to help understand adult firesetting behaviour, the M-TTAF.

The Multi-Trajectory Theory of Adult Firesetting (M-TTAF)

The M-TTAF developed by Gannon et al., (2012) was based on review of motives, typologies, etiological features of one-time and repeat firesetting, pre-existing models and the strengths and weaknesses of various classification and theoretical approaches in the literature. The authors integrated this array of research knowledge into one comprehensive theory of firesetting. It is proposed that this may help explain the broad range of recidivistic behaviour and assist with the assessment, formulation and treatment of adult firesetters (Gannon et al., 2012). The model is an empirically informed theoretical framework that examines the development and maintenance of firesetting behaviour. The M-TTAF adheres to the principles of the "theory knitting" perspective (see Kalmar & Sternberg, 1988; Ward &

Hudson, 1998) and integrates pre-existing models and theories alongside additional components to develop their theory (Gannon et al., 2012).

At the tier one level, the M-TTAF describes a comprehensive etiological approach which identifies a range of factors that become critical risk factors that lead to firesetting behaviour (Gannon et al., 2012). This commences with the developmental context which refers to the historical background of an individual. This context includes static risk factors (as discussed, are historical and unchangeable risk factors), such as; the caregiver environment, biology/temperament, schooling, learning and cultural forces (Gannon et al., 2012). These risk factors contribute to the psychological vulnerabilities, such as; excessive and inappropriate fire interest/scripts, interpersonal and relationship skills, offence-supportive attitudes, cognitive skill deficits, self/emotional-regulation issues and communication problems (Gannon et al., 2012). These vulnerabilities interact with proximal factors and triggers (internal cognitions, biological, social isolation, cultural, individual and contextual/life events) and key moderators of underlying vulnerabilities (mental health and self-esteem/poor self-image) to eventually become critical risk factors for firesetting behaviour (Gannon et al., 2012). The authors believe that these critical risk factors are existing psychological vulnerabilities that become exacerbated prior to firesetting and presents clinical issues post firesetting. These clinical issues are likely to be anger, poor coping and problem-solving skills and inappropriate fires-coping scripts (Gannon et al., 2012).

The authors stress that the M-TTAF theory was designed to incorporate adult firesetters rather than confining to childhood or adolescence firelighters (see Lambie & Randell, 2011) to include both male and female genders and those with mental health disorders. In doing

this, the model widens its scope of applicability as a theory and conceptualise mental health and self-esteem as moderators for other risk factors such as psychological vulnerabilities (Gannon et al., 2012). This is viewed as a step forward towards a holistic approach to understanding firesetting behaviour and a move from unjustifiable distinctions of mentally disordered and non-mentally disordered firesetters (Gannon et al., 2012).

At the tier two level, Gannon et al., (2012) propose five prototypical trajectories that may account for various subtypes of offenders that are explored in the firesetting literature and help guide assessment and treatment. The key trajectories that are associated with firesetting behaviour, are first; the antisocial cognition trajectory, who are primarily the criminals, or those who are part of an antisocial group or part of a wider criminal lifestyle who set fires instrumentally (Gannon et al., 2012). The prominent risk factors are offense-supportive attitudes and values which promote general criminality. The potential motivators here are vandalism, boredom, crime concealment, profit and revenge. Second, the grievance trajectory, are those individuals who have self-regulation issues, high levels of anger, hostility, and fire-aggression and have poor levels of assertiveness and communication skills (Gannon et al., 2012). These firesetters may resort to setting fires as a warning or for retribution/revenge. Third, the fire interest trajectory, these firesetters have an inappropriate fascination and elevation for fire interest, fire paraphernalia, hold offense-supportive attitudes and intense emotional arousal when they set fires (Gannon et al., 2012). This trajectory is typically driven by thrill seeking, fire interest, stress and boredom. This group are unlikely to live criminal careers but may have a lifelong association with fires (Gannon et al., 2012).

Fourth, are the emotionally expressive or the need for recognition trajectory, these make up the two main subtypes for this trajectory (Gannon et al., 2012). For the emotionally

expressive, it includes those with emotional regulation issues in the form of poor problem solving and high impulsivity. This subtype typically draws attention to themselves based on their emotional needs and they may use fire as a cry for help, self-harm or suicide (Gannon et al., 2012). The second subtype of this trajectory is the need for recognition, this includes those with communication problems, those who pre-plan their fires, and gain significant social attention and status from putting out the fires or helping others such as "heroic" firesetters (Gannon et al., 2012).

Last, is the multi-faceted trajectory which includes firesetters possessing prominent risk factors such as offense-supportive attitudes and values that promote general criminality and have extensive and pervasive firesetting history (Gannon et al., 2012). This trajectory refers to firesetters that have communication and self-regulation problems, are highly fascinated with fires, have antisocial attitudes, conduct disorders and antisocial personality disorders (DSM-IV-TR, 2000) and tend to have wider general criminal careers (Gannon et al., 2012). The tier two of the theory presents different subtypes of firesetters that may be seen in practice but unfortunately the five trajectories presented offer little guidance in identifying the level of recidivism for each firesetter in their trajectory.

Overall, the M-TTAF is a recently developed theory to aid the understanding of deliberate adult firesetting and is consistent with several firesetting theories that incorporate general criminal behaviour, clinical psychology and contemporary social-cognitive psychology (Gannon et al., 2012). The aim of the authors was to embrace the key strengths of previous firesetting theories and combine this with other crucial theoretical components and factors. The theory represents a broad scope of currently accepted theories and components into one structured firesetter framework that helps guide approaches to risk assessment, risk

management and instrument selection (Gannon et al., 2012). The M-TTAF describes the interplay between proximal factors/triggers, developmental context, biology, learning, cultural influences, psychological vulnerabilities, moderators, critical risk factors and its relationship to adult firesetting behaviour (Gannon et al., 2012).

The M-TTAF is one of the only theories to explicitly discuss these risk factors which are generally dynamic in nature (Gannon et al., 2012). The only static risk factor in this theory are those captured within the developmental context domain (the historical background). The theory has provided additional psychological understanding of firesetting behaviour which has led to other recently developed theories; the Firesetting Offence Chain for Mentally Disordered (FOC-MD; Tyler et al., 2014) and the Descriptive Model of Adult male Firesetting (DMAF; Barnoux, Gannon, & O'Ciardha, 2015). We will briefly discuss these two theories.

The Firesetting Offence Chain for Mentally Disordered (FOC-MD)

Tyler et al., (2014) developed the first offence chain model (FOC-MD) for mentally disordered male and female firesetters (MDF's) and consists of four phases; background, early childhood, pre-offence and post-offence periods. The FOC-MD helps explain mental health as a moderator for firesetting, which in the presence of other risk factors and motives increase the likelihood of firesetting (Gannon et al., 2012). The FOC-MD holds clinical utility and guides practitioners to develop individualised risk management plans for mentally disordered firesetters (Tyler et al., 2014). However, the utility of the FOC-MD is only limited to mentally disordered firesetters and is not applicable to non-mentally disordered firesetters.

The Descriptive Model of Adult male Firesetting (DMAF)

The DMAF offence chain primarily focusses on imprisoned firesetters and investigates the events that lead-up to their firesetting behaviour (Barnoux et al., 2015). The DMAF is structured to provide an in-depth explanation of firesetting motives that includes triggering events such as; moral transgressions, conflict/provocation and unmet needs that result in emotional responses leading to deliberate firesetting (Barnoux et al., 2015). Similar to the FOC-MD, the DMAF consists of four phases; background, early adulthood, pre-offence and post-offence periods and highlights factors such as; fire interest, normalisation of fire, deliberate firesetting and negative fire experiences (Barnoux et al., 2015). These factors are viewed as clinically relevant risk factors that can be mapped onto risk management plans for imprisoned adult male firesetters. Overall, these micro-theories have supported the development of future theories and treatment interventions for firesetters (Barnoux et al., 2015).

Now that we have discussed the M-TTAF and its applicability with other recently developed micro-theories (FOC-MD, DMAF) we will now briefly discuss the M-TTAF's applicability in two UK firesetting treatment programmes; the Firesetting Intervention Programme for Prisoners (FIPP) and the Firesetting Intervention Programme for Mentally Disordered Offenders (FIP-MO).

The Firesetting Intervention Programme for Prisoners (FIPP)

The FIPP developed by Gannon et al., (2012) is based on the M-TTAF theory and empirical research of male firesetters (see Dickens & Sugarman, 2012; Fritzon, Doley, & Clark, 2013;

Gannon et al., 2013; Gannon et al., 2012; Gannon & Pina, 2010). The FIPP is an evidence-based specialist cognitive behavioural treatment (CBT) programme designed to target key psychological factors associated with adult male arsonists detained in UK prisons (Gannon et al., 2015). The programme addresses four main components that are empirically associated with deliberate firesetting, these are; fire-related factors, offense-supportive cognitions (attitudes supporting violence and anti-social behaviour), emotional regulation (locus of control, anger, regulation and tolerate provocation) and social competency, such as; self-esteem, assertiveness and emotional loneliness (Gannon et al., 2015). The findings suggest that specialist interventions such as CBT successfully reduce key psychological factors associated with firesetting and is best tailored for prisoners with serious firesetting histories (Gannon et al., 2013; Hall, 1995; Swaffer et al., 2001; Taylor et al., 2002, Taylor et al., 2006).

The Firesetting Intervention Programme for Mentally Disordered Offenders (FIP-MO)

The FIP-MO is a recently developed specialist semi-structured intervention programme by Gannon and Lockerbie (2011; 2012; 2014; 2017) and is designed for both male and female mentally disordered patients with a history of deliberate firesetting (either convicted or unconvicted). The FIP-MO was developed as a "sister" programme of the discussed FIPP, but the FIP-MO has a clinical focus that provides a standardized psychological treatment and specialist intervention programme with the UK mental health services and forensic psychiatric hospitals (Tyler et al., 2018). Like the FIPP, the FIP-MO programme is based on existing empirical and theoretical literature on firesetting (Gannon & Pina, 2010; Tyler & Gannon, 2012). The authors incorporated elements from leading theories such as the M-TTAF (Gannon et al., 2012), the Risk-Need-Responsivity model (Andrews & Bonta, 2010) and the Good Lives Model (Ward & Stewart, 2003).

The FIP-MO targets five key psychological factors that are empirically associated with firesetting, these are; fire related factors (problematic fire interest and associations with fire), offence supportive attitudes, social competency, self-management/coping skills and risk management, such as; the understanding of risk factors associated with firesetting and the development of risk management plans (Tyler et al., 2018). The findings from the FIP-MO programme suggest that treatment is effective for reducing some of the key firesetting factors compared to standard general treatment programmes (Tyler et al., 2018). This supports that specialist firesetting intervention programmes for mentally disordered patients are the most appropriate for addressing the psychological factors (such as; specific fire-related deficits) associated with deliberate firesetting. (Tyler et al., 2018).

The FIP-MO neatly addresses one of the key research questions in this thesis; to what degree should individuals who commit arsons be assessed, managed and treated uniquely in the criminal justice system. This work by Tyler and colleagues (2018) suggest that firesetters should be treated uniquely using specialist firesetting intervention programmes compared to relying on general offending behaviour programmes. The FIPP and FIP-MO programmes are unique in the sense that they are both empirically informed specialist treatment programmes specific to firesetters in the UK. Both programmes address key psychological factors and needs that are empirically associated with firesetting behaviour and both programmes are underpinned by the M-TTAF theory which target dynamic risk factors (criminogenic needs) that are directly associated with firesetting.

The FIPP and FIP-MO treatment programmes were developed in collaboration with the Centre of Research and Education in Forensic Psychiatry and Kent Forensic Psychiatric Services. Both programmes have been subjected to multi-site research evaluations (see

Gannon et al., 2015; Tyler et al., 2018) and are currently undergoing further evaluation in the UK (see Tyler, Gannon, & Sambrooks, 2019). Within-treatment evaluations for both the FIPP and FIP-MO have been published (see Gannon et al., 2015; Tyler et al., 2018).

We will now progress onto the next topic and discuss several published studies over the last 40-years that have investigated arson recidivism and arson risk factors with an emphasis on well supported and promising arson risk factors identified in the literature. The following published researchers in this next topic have not developed or proposed any arson predictive models or arson actuarial risk assessments tools for arson recidivism (except Field, 2015). Nonetheless, their contribution in the field has been instrumental in guiding and developing risk prediction models and arson actuarial risk assessment tools for arson recidivism.

Arson Recidivism and Arson Risk Factors

Are arson offenders likely to reoffend by setting another fire? The extensive psychiatric literature suggests that firesetters are a dangerous group of individuals who are likely to set additional fires on release (Quinsey et al., 1998) and are often thought to be a consequence of psychiatric disorders (Ritchie & Huff, 1999). However, based on the limited empirical data for arson offending there is limited support for these beliefs (Quinsey et al., 2006b). This is further supported by a literature review conducted by Brett (2004) who state that the empirical literature provides little help when assessing an individual firesetter and cannot support the hypothesis that firesetters are inherently dangerous (Brett, 2004). A review conducted by Gannon and Pina (2010) conclude that until recently, the substantial research on firesetters were approached from a psychiatric perspective and written from a psychiatric standpoint.

The overwhelming consensus on the arson literature is that there is a lack of empirical work identifying firesetting risk factors and there are limited tools to measure such risk factors (Doley et al., 2011). Although, what we do know is that the rates of arson recidivism vary considerably from 4% to as much as 60% (Brett, 2004). Some seventy years ago, Lewis and Yarnell (1951) conducted the first empirically based US study of pathological firesetters and arson recidivism. In their study of 1345 male and female arsonists, their findings suggest that 26% of the firesetters had set more than one fire. The heterogeneity in arson recidivism rates reported across arson studies are subjected to variable designs, sample biases and different populations drawn from forensic, psychiatric, criminal or general settings (Brett, 2004). For example, the work conducted by Lindberg et al., (2005) suggests that mentally disordered firesetters tend to have higher rates of recidivism than non-mentally disordered firesetters. Given that the magnitude and true extent of arson is far from known, arson is viewed as one of the most-deadly forms of criminal behaviour and well worthy for any arson prevention initiatives (Davis & Ogloff, 2008). The following arson studies have reported that arson recidivism rates are generally low compared to the recidivism rates for violent and non-violent offenders. We will now briefly provide an overview in chronological order, capturing some of the key research findings from leading published researcher in the field. The purpose of this topic is to provide an indication of the scope of arson recidivism and arson risk factors which are identified in the literature. Some authors and studies may not have been included in this topic, which does not suggest that their work is irrelevant or not important, it simply means we only obtained a snapshot of some studies captured in the literature over the last four decades (1978 to 2018).

Commencing with the oldest study in this topic; Sapsford, Banks and Smith (1978) conducted a British study which examined criminal records and prison files of convicted male arson

offenders. This retrospective study by Sapsford et al., (1978) compared life sentenced firesetters (n = 23) with two other firesetter samples (n = 96/147) who served determinate prison sentences of 18 months or more. A follow-up period commenced after their release from prison between 1970 and 1973 and were subsequently followed up for 3-years and 5-years (Sapsford et al., 1978). The purpose of their study was to compare groups of sentenced arsonists (determinate vs life-serving) and identify which factors best predict arson recidivism. Their findings suggest that 2.1% of those arson offenders serving determinate prison sentences of less than 5-years for arson were reconvicted of another arson offence (Sapsford et al., 1978).

Further, 20% of those arson prisoners released from custody having served 5-years or more for arson were reconvicted of a subsequent arson offence (Sapsford et al., 1978). That is, those arsonists sentenced to prison for 5-years or more for arson were 10 times more likely to be reconvicted for an arson offence by the end of their 5-year follow up period ("at risk" period to reoffend) compared to arsonists serving less than 5-year prison sentences (Sapsford et al., 1978). At the 3-year follow up period, the difference was 6-times greater. That is, 2.7% of arson offenders with less than 5-years in prison for arson were reconvicted of another arson offence, whilst 15.2% of arson offenders serving more than 5-years in prison for arson were reconvicted for arson on release (Sapsford et al., 1978). The life sentence firesetter group had little in common with the short-term firesetters, but had more similarities to those serving 5-year plus prison sentences (Sapsford et al., 1978). The study identified that a previous conviction for arson was evident in 47 of the 226 cases.

For the first time in a multiple regression series, this study identified that a previous history of a specific offence as opposed to general criminality was a strong predictor for future

offending (Sapsford et al., 1978). This study further supported previous arson recidivism data that the single best predictor for arson recidivism was previous arson convictions (Brett, 2004; Quinsey et al., 1998; Rice & Harris, 1996; Kolko & Kazdin, 1994; Stewart & Culver, 1982). Similarly, for general offending, the single best predictor for future convictions was the number of past convictions (Sapsford et al., 1978). In addition, adding total previous convictions (including arson offences) did slightly improve overall prediction accuracies (Sapsford et al., 1978).

The authors also investigated similarities between subsequent arson, sexual, violent and property offences between arsonists and other types of offenders. It was identified that arsonists on release were just as likely to commit a violent offence and a non-violent offence and that the rates for arson and sexual re-offending were somewhat lower compared to violent and property-related offences (Sapsford et al., 1978). However, these results are somewhat inconclusive and the true extent of any relationships between arson, violent and non-violent offending is yet to be determined (Quinsey et al., 1998). It is important to treat these findings by Sapsford et al., (1978) with caution given that published work in 1978 by contemporary scientific standards is problematic and the data collection tools employed are questionable. Other limitations in this work include more than 50% of missing cases in the 5-year follow up period, small effect size and no statistically significant results reported in their study. Further, this study relied on a prison-based cohort which does limit the generalisability to the wider population of arson offenders. However, this piece of research by Sapsford et al., (1978) does provide some balance to the exclusively relied upon psychiatric samples used in the literature during this period.

A study conducted by O'Sullivan and Kelleher (1987) examined 54 firesetters from the South West of Ireland. Of these, 17 cases came from a prison in Cork County and the remaining 37 cases came from psychiatric hospitals from the Southern Health Board (O'Sullivan & Kelleher, 1987). For the purposes of this study, a final sample of 34 firesetters were used and followed-up with all post arson offences recorded. The authors identified that after the initial arson offence, 19 of the 34 (35%) firesetters committed a subsequent fire during the follow-up period. Of these, 6 were recurrent firesetters, who were engaged in repeated arson offences, 7 had an arson reoccurrence within the first 6-months of their initial arson offence and the remaining 6 cases had an arson reoccurrence between 6-months and 10-years after their initial arson offence (O'Sullivan & Kelleher, 1987). Based on these findings O'Sullivan and Kelleher (1987) emphasized the importance of adequate assessment and follow-up to reduce high arson reoccurrence rates (O'Sullivan & Kelleher, 1987). Although, it must be stressed that this piece of research was more descriptive and did not report any inferential statistics.

The work conducted by Virkkunen, Eggert, Rawlings, and Linnoila (1996) investigated 41 firesetters and 73 violent offenders in Finland who were identified by the Finnish Courts for forensic psychiatric evaluations (Virkkunen et al., 1996). The purpose of this study was to follow-up arson and violent samples and measure recidivism rates and the role of psychiatric and biochemical variables among the separate groups. Overall, the results from this study could not clearly identify and distinguish an arson offender from a violent offender in terms recidivism and index offences (Virkkunen et al., 1996). Thus, these initial indications suggest that arson is not a unique and separate category of offending which is not distinguishable from other offence types such as violent crimes. Although, these findings must be treated with a great deal of caution given that the sample obtained were under forensic psychiatric

evaluations by the courts and not necessarily reflect the wider criminal population of Finnish arson offenders.

Next, the work conducted by Barnett et al., (1997) compared mentally disordered firesetters with non-mentally disordered firesetters who were convicted in former West-Germany between 1983 and 1985. This sample was representative of all arson offenders who were processed by the West German courts and were subsequently followed-up for an average 10-years. Court trial records were reviewed and the number of firesetting incidents and all other crimes both prior and post index offence were recorded for analysis. The purpose of this study was to identify any subgroups of arson offenders who were high-risk for repeat arson offending (Barnett et al., 1997). The authors identified that from the 844 individual cases convicted for an arson offence, 66% (*n* = 187) of those were criminally "responsible" for their arsons, 22% (*n* = 186) were found "not responsible" for their arsons and 9% (*n* = 97) had "diminished responsibility" for their arsons due to psychiatric reasons (Barnett et al., 1997). Further investigation into arson recidivism rates for the narrowly defined subgroups (responsible, not responsible and diminished responsibility) found that 4% of the fully responsible firesetters, 9% of the not responsible firesetters and 10% of the diminished responsible firesetters had committed a subsequent arson offence during the follow-up period (Barnett et al., 1997).

These results indicate that the group most likely to be arson recidivists were the diminished responsible firesetters (Barnett et al., 1997; Muller, 2008) and that mentally disordered arsonists are somewhat different to non-mentally disordered arsonists. These findings suggest that mentally disordered firesetters are more prone to committing fire-related offences, tend to have higher rates of arson, higher rates of arson recidivism and committed relatively fewer

common offences compared to non-mentally disordered firesetters (Barnett, et al., 1997; Lindberg et al., 2005). Further, the findings suggest that mentally disordered arsonists generally do not have particularly extensive criminal careers but were more likely to have prior arsons and have higher levels of arson recidivism (Barnett et al., 1997).

Following this, Barnett, Richter and Renneberg (1999) extended on their previous work and used the same cohort and follow-up period from the original Barnett et al., (1997) study. The aim of this second retrospective study was to determine whether high-risk subgroups of arson offenders (those with increased proclivity for arson recidivism) could be identified and subsequently classified into mixed or pure arson offenders (Barnett et al., 1999). The authors conclude from this study that there were no significant differences in arson reconviction rates between the 'not responsible', 'diminished responsibility' and 'criminally responsible' arson subgroups (Barnett et al., 1999). However, when classified into mixed vs pure arsonist subgroups, the pure arsonists with diminished responsibility were more likely to set more fires compared to the fully responsible and not responsible arson subgroups (Barnett et al., 1999). Further, arson offenders who were partly responsible at the time of their arson index offence committed more fire-related offences than the fully responsible and non-responsible pure arsonists (Barnett et al., 1999). Although, the study indicates that the follow-up period was measured up to August 1994, the average length of follow-up or "at-risk" period was not clearly specified from the authors. Therefore, it is impossible to determine any incarceration periods which may have compromised the follow-up periods and overall recidivism results (Field, 2015).

Next, a study conducted by Soothill et al., (2004) investigated convicted arson offenders from three separate cohort studies in England and Wales (see Soothill & Pope, 1973). This study

compared and replicated the original 1951 arson cohort series with two further arson cohort series from the same jurisdictions. The aim of this 2004 study was to investigate the criminal careers of arsonists and compare them against the previous arson cohort series. After a twenty-year follow-up period arson re-offending had more than doubled from 4.5% in the original 1951 arson cohort series to 10.7% in the 1980-81 arson cohort series (Soothill et al., 2004). In addition, for the arson offenders who served longer custodial sentences their recidivism rates were slightly higher (Soothill et al., 2004). That is, for those arson offenders who served less than 5-years imprisonment, 8.8% committed a further arson while on release. In contrast, arson offenders serving more than 5-years imprisonment, 12.5% committed additional arsons while on release (Soothill et al., 2004). These findings indicate that arson recidivism is relatively low but does present a small but persistent minority of arson offenders (Soothill et al., 2004). Interestingly, reports indicate that serial arsonists on average set around 31 fires until they are eventually caught or apprehended (Sapp et al., 1994). These findings do present a clear and disturbing pattern of behaviour by arson recidivists.

These findings are also consistent with the research conducted by Sapsford et al., (1978) who suggest that only about 6% of arsonists released from prison would re-commit further arsons within three-years. The arson cohort study conducted by Edwards and Grace (2014) identified that 6.2% (77/1250) of NZ arson offenders committed a subsequent arson offence during their 10-year "at-risk" follow-up period. Similarly, the findings by Ducat et al., (2015) identified that 5.3% of the firesetters from the Australian State of Victoria were subsequently charged for another fire-related offence.

Kennedy et al., (2006) conducted a review of the firesetting literature with the aim of identifying risk predictors of arson recidivism for young offenders. Of note, these reviews

have seen more extensive research conducted on children and adolescent firesetters with less emphasis on adult firesetters. The review identified that the best predictor for firesetting recidivism was previous firesetting behaviour (Kennedy et al., 2006). This is consistent with the adult firesetting literature that the best predictor of future firesetting was previous firesetting (Brett, 2004; Quinsey et al., 1998; Rice & Harris, 1996; Kolko & Kazdin, 1994; Stewart & Culver, 1982; Sapsford et al., 1978). This finding of previous firesetting history is also consistent within the mental health literature (Burton et al., 2012). In addition, the review identified that arson recidivists had greater levels of fire interest and fire-related activities, were more likely to be male and older than non-arson recidivists (Kennedy et al., 2006). These variables identified may provide key relationships to predicting the risk of arson recidivism among young firesetters. Therefore, these factors should be investigated, evaluated and incorporated into any risk assessment tool (Kennedy et al., 2006).

A survey conducted by Jayaraman and Frazer (2006) examined 34 arson offender's pre-trial court and criminal justice records from England and Wales between 1999 and 2003. The findings from this study identified that of the 34 arson offenders, 23 had previous firesetting history (from a special interest in fires to firesetting recidivism to pyromania) and the remaining 11 cases were first-time arsonists. Seven of these cases were assessed as high-risk for arson re-offending and twenty-seven cases were deemed as low to moderate risk for arson recidivism (Jayaraman & Frazer, 2006). Further, 19 of the 34 (65.8%) arsonists were involved in some type of vandalism or building damage-related offending. Overall, two-thirds (67.6%) of the arsonists in their study had a previous history of firesetting and 65% had prior criminal convictions of some type (Jayaraman & Frazer, 2006; Muller, 2008).

This work is supported by a comprehensive review by Gannon and Pina (2010) who conclude that adult firesetters are generally criminally versatile and are more aligned to property type offenders than violent type offenders. Similarly, the work conducted by Dickens et al., (2009) suggests that repeat firesetters were significantly more likely to have convictions for property-type offences, spent more time in prison and were younger at their first conviction. There is now strong evidence that points to extensive criminal histories as a key predictive factor for firesetting recidivism (Rice & Harris, 1991; Ducat et al., 2015).

Dickens et al. (2009) conducted an observational case-control study on adult arsonists (*n* = 167) in England who were referred for a forensic psychiatric assessment over a 24-year period. Their aim was to review case file notes, reports and criminal conviction data (supplied by the Home Office) and identify variables that could classify repeat firesetters from one-time firesetters (Dickens et al. 2009) and also investigate the role of the seriousness of the fire. Consistent with previous research, the review identified that repeat firesetters were younger, more often single (have relationship difficulties), prior family history of violence, a history of enuresis and personality disorders (but not a psychiatric illness), earlier age and onset of first conviction, spent more time in prison, have more convictions for property-related offences and be more criminally experienced, poor school adjustment, evidence of a range of psychosocial disadvantages in their background and suffer from learning disabilities (Dickens et al. 2009).

In terms of offence-related emotional states, Dickens et al., (2009) identified that firesetter recidivists experienced physiological changes such as feelings of excitement, tension and anxiety during their firesetting episode. The authors did not identify any strong links between firesetting recidivism and the seriousness of the fires for which they set. Given this research

was based primarily on psychiatric case notes and reports it is possible that the acute and highly clinical nature of emotional states associated with offending were not routinely recorded and therefore resulted in low prevalence rates (Dickens et al. 2009).

Doley and colleagues (2011) reviewed the literature on risk factors for arson recidivism in adult offenders with a focus on distinguishing one-time firesetters from serial (repeat) firesetters. Studies in this area rest on two assumptions; first, that arsonists are different from non-arsonists, second, repeat arsonists are different from one-time arsonists (Doley, 2009). The authors indicate that firesetters rarely engage in only arson offences and that the role of risk factors and criminogenic needs relevant to general offending is important. By this, patterns of prior criminal offending and antisocial behaviour appear to be important features when evaluating the risk of arson recidivism (Doley, 2009).

Consistent with previous research, serial arsonists have a history of committing other crimes which are predominantly property-related offences (Doley, 2009, Barnett & Spitzer, 1994; Hurley & Monahan, 1969). Other risk factors important to the risk assessment of other crime-types are likely to be relevant for arson offending. This includes criminal history, cognitive and mental illness, sociodemographic factors, social perception, empathy and emotional states (close to the firesetting episode). The authors note that general recidivism tools such as the LSI-R or LS/CMI (Andrews & Bonta, 1995; Andrews, Bonta, & Wormwith, 2004) could be an appropriate first step in individualising risk assessments for the arsonist.

Doley and colleagues (2011) state that since their review, there have been no extensive evaluations of instruments or structured arson risk assessment tools to assess the risk of firesetting recidivism. The authors suggest that this is partly due to limited instruments

developed to deal with such a complex issue. It is stressed that developing such structured and specific tools for firesetters that practitioners must combine a variety of known or suspected risk factors into their risk assessments. This may include incorporating protective risk factors into any comprehensive arson risk assessment (Dolan, McEwan, Doley, and Fritzon, 2011).

The findings from this review suggest that prolonged and sustained fascination with fire and its fire trappings (emergency services arriving and witnesses at scene), previous detected and undetected fire-sets, substance abuse, younger age, lower intelligence and less likely to have a history of aggression are all significant risk factors for repeat firesetting (Rice & Harris, 1996; Doley et al., 2011). The authors state that while the identification of risk factors for firesetting recidivism is in its infancy there is considerable scope for further development of a structured risk assessment tool for adult firesetters. To advance the field, the authors recommend well-designed, large-scale retrospective and prospective research is clearly warranted.

The work conducted by Field (2015) investigated empirically derived risk factors for arson recidivism in adult offenders. The literature review section of Field's (2015) work investigated 15 arson studies between 1970 and 2015. These studies met the authors criteria for inclusion and data obtained from the studies were extracted and evaluated using a designed quality assessment tool (Field, 2015). The data obtained was further reviewed and specific risk factors for arson recidivism were identified and ranked according to the supporting evidence presented. Five of the 15 studies in this review contributed to majority of the supporting evidence (see Edwards & Grace, 2014; Rice & Harris, 1991, 1996; Ducat et al., 2015; Dickens et al., 2009).

The review identified five key risk factors which are reasonably well supported and were noted as the most reliably associated risk factors for arson recidivism, these were; young age at time of first firesetting incident or conviction (Ducat et al., 2015; Edwards & Grace, 2014; Rice & Harris, 1991, 1996), young age at time of index offence (Ducat et al., 2015; Rice & Harris, 1991), the total number of previous arson convictions/offences (Ducat et al., 2015; Edwards & Grace, 2014; Rice & Harris, 1996; Sapsford et al., 1978), being single/never married (Dickens et al., 2009; Rice & Harris, 1991) and the presence of a personality disorder diagnosis (Dickens et al., 2009; Rice & Harris, 1991). The three factors most relevant to this thesis (static risk factors) were; firstly, young age at their first firesetting or firesetting conviction. This factor was supported by four empirically based studies and was consistently associated with firesetting recidivism. Second, young age at their arson index offence, this factor was supported by three empirical studies and emphasized the association with young age and arson recidivism. Third, having a previous arson conviction, this factor was supported by four studies and provided strong support that prior arson offending is highly associated with arson recidivism.

Further, the review identified several promising risk factors associated with arson recidivism, these were; younger age at first criminal conviction (Rice & Harris, 1996; Ducat et al., 2015), multiple arson convictions at the criterion/index offence (Edwards & Grace, 2014; Ducat et al., 2015), history of vandalism/property offences (Edwards & Grace, 2014; Dickens et al., 2009), learning disability (Dickens et al., 2009; Rice & Harris, 1996), lower level of school adjustment (Dickens et al., 2009; Rice & Harris, 1991), feelings of excitement/tension/release associated with firesetting (Rice & Harris, 1991; Dickens et al., 2009), lower levels of violence/aggression (Rice & Harris, 1991, 1996) and the absence of psychosis or delusional motives for firesetting (Dickens et al., 2009; Rice & Harris, 1991, 1996). The static risk

factors most relevant to this thesis were; firstly; young age at their first criminal conviction, this risk factor was identified in two studies. Secondly, having more than one arson charge or multiple arson offences at their first arson court hearing date/arson index offence date. This risk factor was identified in two empirical studies. Thirdly, having a history of prior vandalism or damage-related offences, this risk factor was identified in two of the studies.

The review identified that many of the specific factors associated with arson recidivism are somewhat different to the risk factors associated with violent and non-violent recidivism (Field, 2015). For instance, Rice and Harris (1991, 1996) provides evidence that the risk factors for arson are somewhat different to the risk factors for violent offenders. Whereby arson offenders are more likely to have lower levels of violence and aggression compared to violent offenders (with no arsons). Although, more recent larger scaled studies have not found that levels of violence and aggression are less common in firesetting recidivism (Ducat et al., 2015; Dickens et al., 2009; Edwards & Grace, 2014). However, the findings presented do address one of the key research questions in this thesis that individuals who commit arsons are qualitatively different from individuals with non-arson criminal histories. Field (2015) concludes that there is a need for the development of both actuarial and structured professional judgement tools to assist in the prediction of arson recidivism. At present, Field (2015) states that there is only one developed and empirically validated actuarial prediction model for arson offenders and that is the work conducted in NZ by Edwards and Grace (2014).

The findings from the work conducted by Field (2015) do remain tentative due to its limitations of fewer female participants (although significantly more than the Edwards & Grace, 2014 study), methodological differences across six international jurisdictions

(England & Wales, NZ, Australia, Canada, Finland and West Germany), the majority of the studies in the review section of Field's (2015) Doctoral thesis were primarily based on psychiatric samples rather than the wider population of convicted arson offenders. Overall, Field (2015) identified reasonably well supported and promising risk factors that may aid in the prediction of arson recidivism and support future arson research.

Last, a recent study conducted by Thomson, Tiihonen, Miettunen, Virkkunen, and Lindberg (2018) investigated the rate of firesetting recidivism and general recidivism from a sample of Finnish pre-trial male firesetters (n = 113). This sample was identified by the Finnish Courts to participate in a forensic psychiatric examination. The average follow-up period for this sample was 16.9 years and all reoffending data was obtained from the Finnish National Police. The findings identified that 18% (n = 20) committed an additional fire, while 74% (84) committed any new criminal offence (Thomson et al., 2018). Further, those firesetters with higher traits of psychopathy (PCL-R > 25) were more likely to reoffend with any crime type compared to those scoring low (PCL-R < 25) on the Psychopathy Checklist-Revised scale (PCL-R: Thomson et al., 2018). Overall, the findings from this study indicate both firesetting and general recidivism rates were high from this sample of male Finnish arson offenders (Thomson et al., 2018). However, similar to the Virkkunen et al., (1996) study, caution must be exercised when interpreting these findings given that this small unique sample does not represent the wider criminal population of Finnish arson offenders or female firesetters.

Summary of the Arson Studies

What are we concluding from all this work and how does this inform and guide our research? To address this, we will now summarise and compare the main findings from this subtopic. The important findings from the empirical-based studies, literature reviews and surveys not only inform and guides our research but also complements our empirical research and future efforts in this field (see chapters 2 and 3).

A concerning trend identified by Soothill and colleagues (2004) is that arson recidivism in England and Wales is on the rise. Although, the likelihood for arson recidivism is relatively low, it is those minority cases that represent a small but highly persistent group of arson offenders. The study by O'Sullivan and Kelleher (1987) in the South West of Ireland identified that 35% of the firesetters in their sample committed another fire during follow-up. The authors do emphasize the importance of sufficient risk assessment tools and adequate follow-up for managing and reducing high arson recidivism rates.

The original multiple regression series conducted in Britain by Sapsford and colleagues (1978) supports arson recidivism data that the single best predictor for arson recidivism is previous arson convictions (Brett, 2004; Quinsey et al., 1998; Rice & Harris, 1996; Kolko & Kazdin, 1994; Stewart & Culver, 1982; Kennedy et al., 2006). This finding of previous firesetting history is also consistent in the mental health literature (Burton et al., 2012). Further, arsonists on release were just as likely to commit a violent and a non-violent offence compared to arson and sexual crimes indicating lower rates of reoffending (Sapsford et al., 1978; Rice & Harris, 1996). As with the growing consensus in the literature, arsonists are generally repeat offenders, but they are not necessarily repeat firesetters or arson specialists (Doley et al., 2011).

The review by Kennedy et al., (2006) which focussed on arson recidivism in young offenders identified that arson recidivists had greater levels of fire interest and fire-related activities and were more likely to be male and older than non-arson recidivists (Kennedy et al., 2006). The variables identified here may provide key risk factors for predicting arson recidivism among young firesetters. The authors do stress the importance that these risk factors are investigated, evaluated and incorporated into any risk assessment tool (Kennedy et al., 2006).

The survey by Jayaraman and Frazer (2006) identified that about two-thirds of the arsonists from England and Wales had a previous history of firesetting and were involved in some type of vandalism or building damage-related offending. Further, two-thirds (67.6%) of the arsonists had a previous history of firesetting and 65% had prior convictions of some type (Jayaraman & Frazer, 2006; Muller, 2008). This supports the review by Gannon and Pina (2010) that indicates adult firesetters are generally more criminally versatile and are aligned to property offenders than violent offenders. This is consistent with previous research that serial arsonists have a history of committing other crimes which are predominantly property-related offences (Doley, 2009; Barnett & Spitzer, 1994; Hurley & Monahan, 1969). On this note, the review by Dickens et al., (2009) suggests that repeat firesetters in England were significantly more likely to have prior property-related convictions, spent more time in prison and were younger at their first conviction. This evidence points to extensive criminal histories as key predictors of firesetting recidivism (Rice & Harris, 1991; Ducat et al., 2015).

The recent study by Thomson et al., (2018) identified that 18% of their Finnish sample committed an additional fire while 74% committed any new criminal offence. Further, firesetters with higher traits of psychopathy (PCL-R > 25) were more likely to reoffend with any crime type compared to those scoring low (PCL-R < 25). Their findings indicate that both

firesetting and general recidivism rates were high from their sample of Finnish arsonists (Thomson et al., 2018). Of interest, the earlier study by Virkkunen et al., (1996) were unable to clearly classify arson offenders from violent offenders in terms of recidivism and index offences. This finding suggests that arson offending is not a separate category of offending and is not clearly distinguishable from other types of crimes such as violent crimes.

Barnett and colleagues (1997) identified the group most likely to be arson recidivists were those who had diminished responsibility for setting fires. The findings from their West German study suggest that mentally disordered adult firesetters were more prone to committing fire-related offences. They hold higher rates of arson, higher rates of arson recidivism and committed relatively fewer common offences compared to criminally responsible firesetters. Further, their findings suggest that mentally disordered adult arsonists do not have extensive criminal careers but were more likely to have set fires in the past and had higher levels of arson recidivism (Barnett et al., 1997). Barnett et al., (1999) extended on this previous work and conclude that there were no significant differences in arson reconviction rates between the 'not responsible', 'diminished responsibility' and 'criminally responsible' arson subgroups. However, pure arsonists with diminished responsibility were more likely to set more fires compared to the fully responsible and non-responsible arson subgroups (Barnett et al., 1999).

The literature review by Doley et al., (2011) suggest that patterns of prior criminal offending and antisocial behaviour are important contributors for evaluating arson recidivism (Doley, 2009). Thus, the authors support that firesetters rarely only engage in arson-related offences. The authors stress the need to include protective risk factors and criminogenic needs (relevant to general offending) into any comprehensive assessment tool for firesetters. The authors identified that prolonged and sustained interest in fires, previous detected and undetected

fires, substance abuse and younger age are important risk factors for repeat firesetting. The authors recommend using structured risk assessment tools for arson recidivism and conclude that large-scale retrospective and prospective studies with well-designed research is warranted.

The work discussed in this subtopic have greatly extended the arson literature and informed our research relating to well supported and promising risk factors for arson recidivism. Several studies discussed here complement the methodology and research design of the Edwards and Grace (2014) study and further provides a platform for future development purposes. The current evidence presented informs and supports the development of second-generation risk assessment tools that are required to estimate the likelihood of arson recidivism occurring. The development of the arson actuarial model developed by Edwards and Grace (2014) has been discussed and reinforced in several of these studies presented (see chapter 2). Likewise, the research conducted by Edwards and Grace (2014) has supported and complemented the work captured in this review. This supports Rice and Harris (1996) notion that the development of a risk prediction tool for firesetters is certainly an attainable goal. This goal compliments Geller (1992) who supports the need for the development of risk prediction tools for firesetters.

From this topic we now have a firm understanding of arson recidivism, a greater awareness of well supported and promising arson risk factors and a snapshot of published arson research over the last four decades which covered multiple jurisdictions which used psychiatric, forensic and criminal justice samples. We will now summarise this topic and present the main findings in Table 6. The main purpose of this table is to simply provide a summary of the key points discussed from the studies addressed in this topic and in chronological order (1978 to

2018). Their overarching aims, objectives of their research, samples used (from mentally disordered firesetters to criminally responsible offenders), sample size (ranging from *n* = 34 to *n* = 5584), varying follow-up periods (from 6-months to 20-years) and recidivism rates (from 2% to 49%) are presented.

Table 6

A Summary of the Key Points from the Arson Studies

Authors	Aims	Sample Size	Follow-up	Recidivism Rate
Sapsford, Banks, & Smith (1978)	Compare determinate sentenced arsonists with life serving arsonists and investigate factors which predict different types of recidivism. Sample of convicted arsonists from England and Wales between 1970 and 1973.	*n* = 266	3 to 5-years	2.1% to 20% sentence type*
O'Sullivan & Kelleher (1987)	Examine 54 firesetters from Cork County Prison and Psychiatric hospitals, South West of Ireland. Identify repeat arson offenders and investigate arson reoccurrence rates during follow-up.	*n* = 34	6 months to 10-years	35% (19)
Virkkunen, Eggert, Rawlings, & Linnoila (1996)	Investigate and follow-up a group of Finnish firesetters and violent offenders. Measure recidivism rates and the role of psychiatric and biochemical variables among the two groups.	*n* = 113	16.9-years	18% (20)
Rice & Harris (1996)	Compare arson, violent and non-violent recidivism from a group of mentally disordered firesetters and identify which factors best predict recidivism types. A sample of mentally disordered firesetters admitted to a Canadian psychiatric hospital between 1973 and 1983.	*n* = 208	7.8-years	16% (33)
Barnett, Richter, Sigmund, & Spitzer (1997)	Compare mentally disordered firesetters from criminally responsible firesetters convicted in former West-Germany between 1983 and 1985. Investigate differences between firesetting and other criminality from both groups.	*n* = 470	9 to 11-years	2% to 11% defined groups*

Barnett, Richter, & Renneberg (1999)	Investigate whether arsonists can be identified as dangerous based on legal categories of criminal responsibility. Sample of arsonists convicted in former West-Germany between 1983 and 1985.	*n* = 470	not specified	49% (81)
Soothill, Ackerley, & Francis (2004)	Investigate the criminal careers of arsonists and compare them with earlier cohorts (1980-1981 series) from England and Wales. Further compare the results from three different arson cohort series.	*n* = 5584	20-years	4.5% to 16.8% disposal/year*
Kennedy, Vale, Khan, & McAnaney (2006)	A review of the firesetting literature based on young offenders and identify any risk predictors for arson recidivism.			review only*
Jayaraman & Frazer (2006)	A survey examining arsonists pre-trial court and criminal justice records from England and Wales between 1999 and 2003.	*n* = 34	not specified	20% (7) high-risk*
Dickens, Sugarman, Edgar, Hofberg, Tewari, & Ahmad (2009)	A review of case files obtained from an adult sample of pre-trial psychiatric referrals in the United Kingdom over a 24-year period. Identify variables which can distinguish between repeat firesetters and non-recidivist firesetters and investigate the role of the seriousness of their fires.	*n* = 167	24-year period	49% (81)
Doley, Fineman, Fritzon, Dolan, & McEwan (2011)	A review of the literature on risk factors for arson recidivism and differentiating serial (repeat) firesetters from "one-off" firesetters. Focus on criminal history, mental illness, sociodemographic, offence-specific/related behaviours, emotional states, cognitions, and protective factors.			review only*

Edwards & Grace (2014)	Develop an empirical-based actuarial model for arson recidivism and compare the risk factors for arson, violent and non-violent recidivism. Based on a NZ cohort of convicted arson offenders between 1985 and 1994.	*n* = 1250	10-years	6.2% (77)
Field (2015)	A systematic review of 15-arson studies and identify various risk factors for arson recidivism in adult offenders. Develop three empirical based actuarial models for arson recidivism for the whole sample, female-only and male-only groups. Data obtained from the UK criminal justice system for English and Welsh arson offenders on 31 March 2013.	*n* = 1805	not specified	16.9% (261)
Ducat, McEwan, & Ogloff (2015)	Determine the rate of firesetting recidivism from a sample of convicted Australian firesetters between 2000 and 2009. Identify psychiatric and criminogenic risk factors for recidivistic firesetting and develop an improper model.	*n* = 1052	2.4 to 14.4-years average 6.9*	5.3% (56)
Thomson, Tiihonen, Miettunen, Virkkunen, & Lindberg (2018)	Investigate the rate of general and firesetting recidivism of pre-trial male firesetters admitted to forensic psychiatric examinations in Finland. Investigate levels of psychopathy (PCL-R) with reoffending rates.	*n* = 113	16.9-years	18% (20)

Note.

1. Fifteen studies made inclusion in this subtopic and may not necessarily include all published research from the available arson literature.
2. This table only provides an indication of the scope of arson recidivism and risk factors identified over the last four decades (1978 to 2018).

Now that we have discussed arson recidivism, arson risk factors and research in this field over the last 40-years, we will now focus our attention towards the development of arson risk assessment tools. We will review the work of four key published researchers who have developed unique predictive model's for arson and firesetting recidivism specific to their research designs, respective samples and jurisdictions. The key researchers we will be discussing in this next sub-topic are; Rice and Harris (1996), Edwards and Grace (2014), Field (2015) and Ducat and colleagues (2015). Two of these authors (Edwards & Grace, 2014; Field, 2015) have extended on their developed arson predictive models and developed empirically based arson actuarial risk assessment tools. These newly developed arson actuarial tools are suitable for operational use within the wider population of arson offenders and in their respective jurisdictions (NZ and England/Wales). We will discuss these proposed tools in further detail throughout this topic.

Arson Predictive Models and Arson Actuarial Tools

As discussed, professionals alike are seeking ways to prevent repetitive firesetting behaviour (Kennedy et al., 2006) and there is still a lot more work that needs to be done to identify appropriate treatment needs and intervention for firesetters (Gannon et al., 2013). Therefore, more rigorous large-scale studies investigating static risk factors are necessary to support and develop actuarial risk assessment tools for arson recidivism (Field, 2015).

Despite the high importance of this goal, there is little known about arson offenders compared to other types of serious offenders, such as violent and sexual offenders (Gannon & Pina, 2010). There is extensive work in the literature on understanding risk factors for violent and general recidivism (Quinsey et al., 2006c), but unfortunately, there is limited research in

identifying factors associated with firesetting recidivism (Brett, 2004; Gannon & Pina, 2010). Further, there is minimal guidance on how to assess and treat repeat arson offenders (Doley et al., 2011; Gannon & Pina, 2010). Arson and firesetting behaviour are deemed a public health issue and as such there is a need and obligation to prevent this important issue. Developing arson risk assessment tools may aid the identification of "at-risk" individuals for arson recidivism and assist with prevention. Given that arson risk assessment tools will impact public safety, national security and the rights and liberties of those assessed it is important that valid and reliable tools are developed. To help advance this limited area of understanding, we will review the important contributions by four key leading developers who have developed predictive models for arson and firesetting recidivism. We will also review the newly developed actuarial risk assessment tools proposed by two of these authors mentioned.

To date, there are the only four published researchers (Rice & Harris, 1996; Edwards & Grace, 2014; Field, 2015; Ducat et al., 2015) who have developed such tools and have contributed to the arson risk assessment literature by providing the majority of evidence in this field. The work discussed here includes, mentally disordered male firesetters and criminally responsible convicted arson offenders, male and female arson offenders, adult and juvenile offenders, five jurisdictions (Canada, NZ, England, Wales and Australia) and capturing 24-years of arson research. We will now discuss the important contributions by these authors in timeline order (1996 to 2015).

Rice and Harris (1996)

A retrospective Canadian study by Rice and Harris (1996) investigated the recidivism and relationships between arson, violent and non-violent offending for 243 mentally disordered firesetters. The authors obtained the same sample of male firesetters who were admitted to a Canadian maximum-security psychiatric facility between 1973 and 1983 (Rice & Harris, 1996). Of that original study, 208 patients had the opportunity to re-offend with an average "at risk" period of 93.6 months. The purpose of this study was to compare arson, violent and non-violent recidivism and identify which factors best predicted each of the three recidivism types (Rice & Harris, 1996).

In an average 7.8-year follow-up, 16% set another fire, 31% committed a violent offence, 57% committed a non-violent offence and 66% committed some type of recidivism (Rice & Harris, 1996; Quinsey et al., 1998). These findings indicate that the variables used to predict firesetting recidivism were somewhat different to the variables used to predict non-violent recidivism and quite different to the variables used to predict violent recidivism (Rice & Harris, 1996; Edwards & Grace, 2014). These results were supported by a multiple discriminant function in which firesetting shared a 3% common variance with violent recidivism but a 34% common variance with non-violent recidivism (Rice & Harris, 1996). These findings suggest that the act of firesetting is unique and different from violent and non-violent crimes but more so for violent crimes (Rice & Harris, 1996; Quinsey et al., 1998).

These indications suggest that arson should be viewed as a unique category of offending that is both distinct and separate from other types of offending such as violent and non-violent crimes. It is this reason that more focus should be directed on investigating factors that

specifically predict arson recidivism rather than examining the wider definitions of recidivism (Field, 2015). Therefore, arson prediction requires an offence specific approach compared to violent and non-violent crimes.

Although, the work conducted by Virkkunen et al., (1996) on a sample of Finnish firesetters were not able to support such findings. That is, the authors were unable to clearly distinguish between arson offenders and violent offenders in terms of recidivism and index offences. Based on their findings, it is indicted that the act of arson is not a unique and separate category of offending. Thus, their findings suggest that arsons are not distinguishable from other types of offences such as violent crimes particularly for a unique group of Finnish firesetters undergoing forensic psychiatric evaluations.

However, in terms of identifying variables that best contribute to firesetting prediction, Rice and Harris (1996) found that young age at first fire setting, childhood firesetting history and higher number of fires set were significantly correlated with firesetting recidivism. Based on these correlations, Rice and Harris (1996) developed the original multivariate prediction equation for mentally disordered firesetters which relied heavily on past firesetting behaviour. The development of the multivariate prediction equation comprised of seven risk factors, these are; young age at first firesetting, higher total number of fires set, childhood firesetting history, lower IQ, no concurrent criminal charges at the index fire, acted alone and lower aggression scores (Rice & Harris, 1996).

The authors identified that the strongest contribution towards firesetting prediction were the historical firesetting factors such as; age at first firesetting and a history of firesetting (Rice & Harris, 1996). Further evidence supports that younger age at first firesetting is a key risk

predictor for firesetting recidivism (Rice & Harris, 1991; Edwards & Grace, 2014; Dickens et al., 2009; Doley et al., 2011). Unfortunately, this study did not extend on their developed predictive model and generate any actuarial models for mentally disordered firesetters. Further, the study did not generate any AUC scores or test the validity or reliability of their multivariate prediction equation.

Overall, the results obtained from the Rice and Harris (1996) study suggests that the development of a risk prediction tool for firesetters is certainly an attainable goal for which their study provides a good starting point (Quinsey et al., 1998; Rice & Harris, 1996). This goal compliments the work conducted by Geller (1992) who reinforced the need for the development of risk prediction tools for firesetters (Rice & Harris, 1996; Quinsey et al., 1998). As a good starting point Edwards and Grace (2014) complements the work by Rice and Harris (1996) and developed such proposing risk prediction tools for firesetters. Next, we will briefly discuss the Edwards and Grace (2014) study with a full description provided in chapter two.

Edwards and Grace (2014)

More recently, Edwards and Grace (2014) extended on the work by Rice and Harris (1996) and developed an arson predictive model and an actuarial model for arson recidivism for the NZ context. The developed predictive model for arson recidivism comprised of three key risk factors, these are; first arson under 18-years, multiple arsons at the criterion offence and having prior vandalism-related offences. Next, the authors developed a 10-point actuarial model for predicting arson recidivism using the same three key risk factors that were generated from the arson predictive model. Unlike the Rice and Harris (1996) study, the

Edwards and Grace (2014) study tested the accuracy of the arson predictive model (AUC score of .68) and the actuarial model (AUC score of .67). A cross-validation strategy was conducted splitting the arson cohort in two even sub-samples *n* = 625 (developmental and validation) to test and support the model's validity.

To the researchers' knowledge, there were no prior published work in NZ and Internationally that has developed, tested and validated actuarial models for the wider criminal justice population of convicted arson offenders. Therefore, the rationale for obtaining a NZ sample of arson offenders (Edwards & Grace, 2014) for chapter two is crucial because there were no developed arson actuarial models in NZ. Further, the need for obtaining a second NZ sample of arson offenders for Chapter 3 is so that the authors may assess the generalisability and utility of the original Edwards and Grace (2014) model.

It is interesting to note that since the published Edwards and Grace (2014) study other researchers such as Field (2015) have developed additional actuarial arson tools using similar methodology employed by Edwards and Grace (2014). In the Edwards and Grace (2014) study, the authors obtained a large scale nationally representative cohort of 1250 criminally responsible (non-mentally disordered) convicted arson offenders in NZ between 1985 and 1994. This type of sample is unique and different to the arson sample obtained by Rice and Harris (1996) which relied heavily on firesetters with forensic and clinical psychiatric backgrounds.

Given that arson is a criminal act which comprise of mainstream individuals that are easily missed or overlooked within the forensic and psychiatric backgrounds. It is important that we investigate and research NZ arson offenders who are dealt with and prosecuted through the

criminal justice system. The Edwards and Grace (2014) study neatly includes all those individuals who make up the wider criminal population of convicted arson offenders in the NZ context. Therefore, there is a great need for second-generation tools in arson research, particularly for the wider and general population of arson offenders. These newly developed tools also complement and support promising third and fourth generation tools.

In the previous section, we discussed the importance of the RoC*RoI as an actuarial measure in NZ. Given its direct relevance to this thesis, it would be beneficial to review any relationships and compare the RoC*RoI model with the Edwards and Grace (2014) model. The RoC*RoI model is based on two statistical risk models, the Risk of re-Conviction and Risk of re-Imprisonment (Bakker et al., 1999) which provides two different risk assessment measures. In contrast, the Edwards and Grace (2014) model is a stand-alone statistical model that only predicts the risk of arson re-offending (recidivism) and not predict the risk of imprisonment or the seriousness of their offending. Both the RoC*RoI model and the Edwards and Grace (2014) model are second-generation actuarial tools that are based primarily on static risk factors and not dynamic or criminogenic risk factors. The RoC*RoI relies on 16-static risk factors to generate their model, whereas the Edwards and Grace (2014) model relies on three key static risk factors to generate their predictive model.

To validate these respective models, both authors split the samples into developmental and validation subsamples and were tested against each other. The predictive accuracy of the RoC*RoI provided an AUC score of .76 which indicates a high level of predictive accuracy (Bakker et al., 1999). In contrast, the Edwards and Grace (2014) actuarial model provides a moderate level of predictive accuracy (.68). Thus, the RoC*RoI model reflects a more

accurate model for risk assessment of offenders compared to the Edwards and Grace (2014) model.

Both models rely on the risk scores obtained from their tools to assist in identifying high-risk offenders from low-risk offenders. Thus, those deemed "high-risk" would receive more intensive treatment, rehabilitation and supervision compared to those identified as "low-risk" offenders. One of the main differences between both tools is their study design and their overall intended purpose. That is, the RoC*RoI model was built on a sample of all types of criminal offenders and was primarily designed to predict future general criminal offending. In contrast, the Edwards and Grace (2014) model is specifically designed to assess and predict a specialist form of offending (arsons and firesetting). This is not a limitation of the RoC*RoI model, given that it was not designed specifically for arson or firesetting crimes. The sample obtained by Edwards and Grace (2014) model relied exclusively on convicted arson offenders. Thus, the model was founded on convicted arson offenders with the goal of providing well-informed predictions for convicted arson offenders. Whereas the RoC*RoI model was founded on all types of convicted offenders. It is indicated that the Edwards and Grace (2014) actuarial model is a more appropriate and specific tool for the risk assessment of arson recidivists compared to the RoC*RoI. It is proposed that specialist actuarial risk assessment tools for arson offenders would greatly enhance the validity, reliability and justification for operational use in the criminal justice system.

The Edwards and Grace (2014) study is reported in full (see chapter 2) and addresses the key foundational and critically important research questions in this thesis, such as; can actuarial tools be created to predict arson re-offending? are arson offenders different from other types of offenders with non-arson histories, such as violent and non-violent offenders? what degree

should individuals who commit arson be assessed, managed and treated uniquely in the criminal justice system? and how can these actuarial tools be used and who would benefit from using them?

Field (2015)

A retrospective case-control study conducted by Field (2015) investigated 1,805 convicted arson offenders serving prison or probationary sentences in England and Wales on the 31 March 2013. The author identified various risk factors that predict arson recidivism from English and Welsh adult arson populations obtained from the UK criminal justice system. The 1,805 arsonists in this study comprised of 261 arson recidivists and 1544 first-time arson offenders, of which 302 were females and 1503 were males. Information was obtained and comparisons made on a range of risk factors obtained from the Offender Assessment System (OASys; Home Office, 2006) and criminal conviction data (Field, 2015). One of the main aims of this study was to investigate previously identified and proposed risk factors for arson recidivism against arson recidivists and first-time arson offenders (Field, 2015). For the whole sample (male and female), arson recidivists were; more likely to be young at the age of their first arson, have a history of criminal damage, have psychiatric disturbances, committed the arson index offence alone, had childhood behavioural problems and lack interpersonal skills (Field, 2015). If we separate the gender groups; female arson recidivists had higher levels of violent offending and were a patient from a secure psychiatric unit. For male arson recidivists, they were more likely to have multiple arson convictions at their arson index offence, motivated by thrill seeking and were homeless and socially isolated (Field, 2015).

Field (2015) used logistic regression to develop three predictive models for arson recidivism, one for the whole sample (male and female), one for the female-only sample and one for the

male only sample. First, for the whole sample, this include eight variables, these were; first arson under 18-years, first criminal sanction (not being prior to 18-years old), having 22+ prior criminal convictions (Police National Computer research database; PNC), prior criminal damage convictions, committing the index arson alone, index motive for thrill seeking, not being a perpetrator for domestic violence and not having a history of binge drinking (Field, 2015). The AUC score for the final model to predict arson recidivism was .84 (Field, 2015).

Next, the regression model for the female-only sample identified four variables that were selected for the final equation, these were; first arson under 18-years, been a patient in a special hospital or medium secure unit, being in company with other offenders during the arson and having prior criminal damage convictions. The AUC score for the female only regression model to predict arson recidivism was .77 (Field, 2015).

Last, the final regression model for the male-only sample identified seven variables that were selected for the final equation, these were; first arson under 18-years, no other offenders involved in the arson index offence, prior criminal damage convictions, not being a perpetrator of domestic violence, the index offence is motivated by thrill seeking, homeless and having 22+ offences on their PNC record. The AUC score for the male only regression model to predict arson recidivism was .85 (Field, 2015).

The next step for the author was to construct three operationalised actuarial risk prediction tools, one for the whole sample (male and female) and two gender-specific risk prediction tools (female-only and male-only groups). Field (2015) replicated a similar methodology originally employed in the Edwards and Grace (2014) study for the development of their actuarial prediction tool. However, instead of the original four risk bands utilised in the Edwards and

Grace (2014) study Field (2015) relied on three risk bands (low, medium and high). First, for the whole sample, the authors developed a 9-point actuarial model for predicting arson recidivism and relied on six risk factors from the predictive model, these were; first arson under 18-years, other offenders involved in the arson index offence, having prior criminal damage offences, 22+ offences on their PNC record, having the thrill-seeking motive for their arson index offence and a history of binge drinking. This excludes first criminal sanction over the age of 18-years and not being a domestic violence perpetrator (Field, 2015). The scores for this tool ranged from 0 to 9 and the AUC score for the whole sample was .79[1] (Field, 2015).

Next, the five final variables used by Field (2015) for the female only sample to develop the actuarial prediction tool were; first arson under 18-years, being a patient in a special hospital or secure unit, having prior criminal damage offences, other offenders involved in the arson index offence and a history of binge drinking. The scores for this tool ranged from 0 to 6 and the AUC score for the actuarial scale for predicting arson recidivism in the female only sample was .81 (Field, 2015).

Last, the six final variables used by Field (2015) for the male only sample to develop the actuarial prediction tool were; first arson under 18-years, having prior criminal damage offences, other offenders involved in the arson index offence, 22+ more offences on their PNC criminal record, having the thrill-seeking motive in their arson index offence and no fixed abode (Field, 2015). The scores for this tool ranged from 0 to 9 and the AUC score for the actuarial scale for predicting arson recidivism in the male only sample was .81 (Field, 2015).

[1] An area under the curve (AUC) score above .71 represents a large effect size (Rice & Harris, 2005), the tool proposed by Field (2015) would be considered suitable for operational use.

Overall, the three actuarial risk prediction tools developed by Field (2015) accurately identifies those from the whole sample, male only and female only groups that are likely to be at greater risk for arson recidivism. Those scoring high on any of the actuarial prediction tools are more likely to commit further arson offences compared to those who score low on any of the arson prediction tools (Field, 2015). These findings support one of the key research questions in this thesis in which actuarial tools can be developed to predict rare offending events such as arson. Field (2015) identified that the gender specific actuarial tools were much more superior in terms of predictive accuracy compared to the whole sample. This finding suggests that arson recidivists are somewhat different amongst themselves, male vs female and that different degrees of assessment using gender specific tools are highly recommended (Field, 2015). Last, the author discusses theoretical, clinical and forensic implications of their proposed operational arson recidivism models (Field, 2015).

Ducat, McEwan and Ogloff (2015)

Around the same time Ducat et al., (2015) conducted a retrospective study in Australia which investigated the psychiatric and criminogenic risk factors for firesetting recidivism. In this study the authors obtained a working sample of 1052 individuals from the Australian State of Victoria who were convicted of an arson-related offence between 2000 and 2009. The individuals were followed-up for an average of 6.9-years with criminal history and subsequent offences recorded for analysis (Ducat et al., 2015). The authors noted that firesetting recidivism was defined as any subsequent charge for any arson-related offence during the follow-up period (Ducat et al., 2015). The findings were that; 5.3% (56) of the arson offenders committed a subsequent arson-related offence, 55.4% (592) had a subsequent

charge for any offence (general recidivism) and 91% were mixed (criminally versatile) offenders during the follow-up period (Ducat et al., 2015).

A consistent finding is that firesetters were reconvicted for other types of offences and had higher recidivism rates and less arson reconviction rates (Field, 2015). The authors conclude that when assessing the risk of firesetting recidivism, clinicians should consider fire-specific history, general criminality and the impact of mental disorders on recidivism (Ducat et al., 2015).

To predict firesetting recidivism, the authors expanded on their work and developed what they describe as an improper model (using the significant univariate predictors obtained from their study). Essentially, an improper model relates to the process whereby the weights assigned to its predictor variables are obtained by non-optimal methods (Ducat et al., 2015; Dawes, 1979). The weights determined are chosen to be equal or they may be chosen based on clinical intuition or maybe chosen at random (Dawes, 1979). Further, continuous predictor variables are collapsed into various categories that are based on statistically and clinically important frequency distributions (Ducat et al., 2015). Therefore, any linear predictive models that are developed statistically (such as proper models) are then modified to remove item weighting are described as improper models. Thus, any actuarial risk assessment tools where the weights from the regression analyses are modified into binary or ordered numbers are deemed improper models and not proper models. The scoring procedures employed for improper models are modelled from other well-known validated risk assessment tools such as the HCR-20 (Douglas et al., 2013).

This improper linear model developed by Ducat et al., (2015) incorporated 16-risk factors that captures key areas such as; general criminality, firesetting history and psychiatric disorders. The 16-variables in the final predictive model were; mixed arsonist (a history of arson plus three other offence types), multiple arson charges (at their index offence), total number of prior arson offences (prior to their index offence), age at first arson offence, a charge prior to their index offence, total number of offences prior to their index offence, non-violent offending prior to their index, age of first offence (for any), criminal versatility (PCL-R definition over six offence types), registered contact with mental health services, Axis I clinical diagnosis, serious mental illness, personality disorder, substance misuse (over a lifetime), child behaviour disorders and treatment with child or adolescent psychiatric services (Ducat et al., 2015). Of these 16-variables, the static risk predictors most relevant to the Edwards and Grace (2014) actuarial model is; young age at their index offence/their first arson offence, less likely to be pure arsonists (committing other types of offences) and have more multiple arsons at the time of their index offence. This improper model provided an AUC score of .74 (Ducat et al., 2015).

Overall, the work developed by Ducat et al., (2015) provides further support to include criminogenic needs and dynamic risk factors into overall risk assessments for firesetters. The authors suggest that those firesetters who hold several risk factors should be prioritised and preferably triaged through the system. That is, the model aids the identification of individuals who may require further risk assessment based on their predicted likelihood of arson reoffending (Ducat et al., 2015). It is stressed that the variables used to develop the model are readily available to Police, corrections, and clinicians (forensic mental health services). This allows for appropriate resources to be allocated to those identified individuals most in need (Andrews & Bonta, 2010; Andrews et al., 2004; Harris et al., 1993).

Unfortunately, similar, to the Rice and Harris (1996) study, Ducat et al., (2015) did not extend on their developed predictive model to generate any actuarial models. Further, this study did not generate any AUC scores or assess the validity and reliability of their proposed predictive model. Last, this study was unable to account for any incarceration periods during the follow-up period.

We now present table 7, which provides a summary of the four empirical studies that have been instrumental in developing arson predictive models and subsequent arson actuarial risk assessment tools for arson recidivism.

Table 7

Summary of the four Empirical Studies that have Developed Arson Predictive tools

Authors	Model Risk Factors
Rice & Harris (1996)	Predicting the recidivism of mentally disordered male firesetters. The authors relied on a Canadian psychiatric sample to develop a multivariate prediction equation that comprised of seven key risk factors; young age at first firesetting, higher total number of fires set, childhood firesetting history, lower IQ, no concurrent criminal charges at the index fire, acted alone and lower aggression scores. The authors did not generate an AUC score for their prediction equation and no actuarial models were developed.
Edwards & Grace (2014)	The authors developed an actuarial model and risk classification scale to aid the prediction of arson recidivism in a NZ context. A predictive model for arson recidivism was developed based on a NZ sample of convicted arson offenders. The model comprised of three significant static risk factors; first arson under 18-years, multiple arsons at the criterion offence and number of prior vandalism offences. A split sample

	cross validation was conducted on the arson cohort, the arson predictive model provided an AUC score of .70 (developmental subsample) and .68 (validation subsample). As a result, the authors generated a 10-point actuarial risk classification scale for predicting arson recidivism. The AUC score for the actuarial model was .67. Both developed models provided a moderate level of predictive accuracy. The authors propose the operational utility for its use in the NZ criminal justice system.
Field (2015)	The author identified risk factors for arson recidivism and developed logistic regression equations based on a sample of English and Welsh arson offenders. The arson predictive equation for the whole sample (male and female) incorporated eight significant variables; first arson under 18-years, first criminal sanction (not being prior to 18 years old), having 22+ prior criminal convictions, prior criminal damage convictions, committing the index arson alone, an index motive for thrill seeking, not being a perpetrator for domestic violence and not having a history of binge drinking. The predictive model for the whole sample provided an AUC score of .84. The author developed a 9-point actuarial risk classification scale for predicting arson recidivism, relying on six key risk factors from the whole sample model (excludes first criminal sanction and not a perpetrator of domestic violence). The AUC score for the whole sample actuarial model was .79. In addition, the author developed gender-specific logistic regression equations and actuarial risk tools which all (except the female-only regression model) produced better results compared to the whole sample models. The author discusses the theoretical, clinical and forensic implications of this work.
Ducat et al., (2015)	The authors investigated firesetting recidivism and factors related to repeat offending. An improper model for recidivistic firesetting was developed from a sample of convicted arson offenders in Victoria, Australia. The predictive model

	comprised of 16 significant static and dynamic risk variables, these are; mixed arsonist, multiple arson charges at their index offence, a total number of arson offences prior to their index offence, age at first arson offence, a charge prior to their index offence, a total number of offences prior to their index offence, non-violent offending prior to their index offence, age at first offence (for any offence), criminal versatility, registered contact with mental health services, Axis I clinical diagnosis, serious mental illness, personality disorders, substance misuse (over their lifetime), child behaviour disorders and reported treatment with juvenile psychiatric services. The model provided an AUC score of .74. No actuarial models were developed from this study. The authors support the use of criminogenic needs and dynamic risk factors for the overall risk assessment of firesetters.

Note.

1. The risk factors for all generated arson predictive models and AUC scores are provided (except for Rice & Harris, 1996).
2. The developed arson actuarial risk assessment models and AUC scores are included for the Edwards and Grace (2014) and Field (2015) studies.
3. Only four empirical-based studies to date have developed arson predictive models and actuarial tools in the arson risk assessment field.

How do these empirical studies compare with the Edwards and Grace (2014) study? For starters, the Rice and Harris (1996) model was based on a small sample (n = 208) and relied on mentally-disordered firesetters admitted to a Canadian maximum-security psychiatric facility. Whereas the Edwards and Grace (2014) study relied on a much larger sample (n = 1250) which captured the wider criminal population of convicted arson offenders in NZ. Rice and Harris (1996) identified that in an average 7.8-year follow-up, 16% set another fire, 31% committed a violent offence and 57% committed a non-violent offence (Rice & Harris, 1996). In contrast, Edwards and Grace (2014) identified that over a longer follow-up period

(10-years), recidivism rates for arson, violent and general offending were 6.2%, 48.5% and 79.3%, respectively (Edwards & Grace, 2014). These findings indicate that arson recidivism rates were higher for mentally disordered firesetters and that violent and non-violent recidivism rates were somewhat higher for the criminally responsible arson offenders.

Rice and Harris (1996) proposed an original multivariate prediction equation based on seven risk factors, of those risk factors three were most relevant to the Edwards and Grace (2014) study, these were; young age at first firesetting, higher total number of fires set and childhood firesetting history. Both authors support the findings that the strongest contribution towards firesetting prediction were; age at first firesetting and a history of firesetting. Both authors further indicate that the variables used to predict firesetting recidivism were somewhat different to the variables used to predict non-violent recidivism and quite different to the variables used to predict violent recidivism (Rice & Harris, 1996; Edwards & Grace, 2014).

Similar, to the Edwards and Grace (2014) study, Ducat et al., (2015) obtained a large sample size (n = 1052) capturing the wider criminal population of arson offenders and were obtained from the Australian State of Victoria. In an average 6.9-year follow-up, 5.3% set another fire, 55.4% committed a general offence and 91% were mixed offenders (criminally versatile). The arson recidivism rate was fairly similar to the Edwards and Grace (2014) study of 6.2%. Similarly, firesetters were reconvicted for other types of offences and had higher recidivism rates for those offences and showed disproportionately less arson reconviction rates (Edwards & Grace, 2014; Ducat et al., 2015; Field, 2015; Rice & Harris, 1996). Ducat et al., (2015) developed an improper model for recidivistic firesetting which comprised of 16 significant static and dynamic risk variables. Of those variables, three risk factors most relevant in the Edwards and Grace (2014) study, were; multiple arson charges at their index offence, total

number of arson offences prior to their index offence and age at first arson offence. The improper model developed by Ducat et al., (2015) provided an AUC score of .74 which is higher than the Edwards and Grace (2014) AUC score of .68.

The Ducat et al., (2015) model comprised of multiple static and dynamic risk factors that included; general criminality and versatility, firesetting history and psychiatric disorders. Some of these risk factors, particularly the criminogenic need and dynamic risk factors were not included in the Edwards and Grace (2014) actuarial tool. These findings suggest that incorporating criminogenic need and dynamic risk factors into an arson predictive tool increases the predictive accuracy and utility of the actuarial model. However, a similar finding between both studies is that arson offenders tend to be criminally versatile and have other prior criminal convictions (other than arsons) and are less likely to be pure arsonists (only committing arsons).

Last, Field (2015) developed similar tools which replicated the methodology used by Edwards and Grace (2014). Field (2015) also obtained a large sample (n = 1805) capturing the wider criminal population of arson offenders from English and Welsh jurisdictions. This study included 302 female arson offenders compared to the Edwards and Grace (2014) study of 4 cases (which appears inconsistent). Field (2015) similarly employed logistic regression to develop their logistic regression equations for arson recidivism; one for the whole sample (male and female) and splitting into female-only and male-only groups. The Edwards and Grace (2014) study did not investigate or generate any gender-specific predictive models and only developed one actuarial model that included both male and female offenders.

For the whole sample in Field's (2015) study, eight risk factors were identified, of those risk factors, two were similar risk factors identified in the Edwards and Grace (2014) study, these were; first arson under 18-years and prior damage-related offences. The AUC score for their regression equation (whole sample) was .84 vs Edwards and Grace (2014) AUC score of .68. Their AUC score provided a much higher level of predictive accuracy compared to the Edwards and Grace (2014) model which provided a more moderate level of predictive accuracy. The predictive equation developed by Field (2015) incorporates five additional risk factors which included dynamic risk factors that were not incorporated in the Edwards and Grace (2014) model such as arson motives (thrill seeking).

Although, Field (2015) replicated the same methodology originally used by Edwards and Grace (2014) for the construction of their actuarial risk prediction tools but relied on three risk bands instead of four. Six variables were used for their actuarial model (whole sample), of these, two were most relevant to the Edwards and Grace (2014) actuarial model, these were; first arson under 18-years and prior damage-related offences. The authors note that vandalism-related offences and damage related-offences are relatively similar offence types and are both property related crimes. Field's (2015) actuarial tool is based on a 9-point risk classification scale which provided an AUC score of .79 vs the Edwards and Grace (2014) 10-point risk classification scale which provided an AUC score of .67. These differences may be attributed to the Field (2015) model incorporating both static and dynamic risk factors, whereas the Edwards and Grace (2014) model only included static risk factors. Overall, both studies have developed empirically validated actuarial risk assessment tools that adopt an evidence-based approach for arson recidivism.

Overall, the work presented in this thesis provides progressive and essential steps towards achieving its overarching aim, goals and at the same time providing a strong contribution to the field of offender risk assessment. It is proposed that this research and the completion of the two empirical-based studies (see chapters 2 and 3) will be of considerable benefit and operational utility for multiple sectors within the criminal justice system, such as; judicial, treatment, custodial, parole and investigations. We will briefly discuss how the arson actuarial tool developed by Edwards and Grace (2014) supports and aids the criminal justice system and multiple sectors who will benefit from implementing these actuarial tools.

CRIMINAL JUSTICE SYSTEM

Judicial

The development of arson actuarial tools will aid expert evidence in relation to assessing propensity, proclivity and arson recidivism of the accused in judicial proceedings at District and Supreme Court matters. Actuarial risk assessment tools may provide evidence to assist judges and magistrates for sentencing and court disposal decisions. Further, assessing the risk level of an accused on expert advice may support key strategies such as suitable electronic monitoring (GPS ankle bracelets) for those deemed “high risk” who are released to bail or on parole. Professionals within the criminal justice system (CJS) are relied upon to make risk informed decisions on the levels of dangerousness of an offender (Cooke & Mitchie, 2013). Therefore, it is important that accurate, valid and defensible evidence-based risk assessment tools are developed to support the judicial system and any judgements made in court.

Treatment

Accurate and valid evidence-based second-generation risk assessment tools may support promising firesetter instruments such as the; SAFARI, NFRA, PFSI and FRAT-Y. It is acknowledged that second-generation tools in isolation do not offer any specific guidance for treatment and rehabilitation particularly when assessing the criminogenic needs and dynamic risk factors of an individual. However, second-generation actuarial tools in combination with third and fourth generation approaches may support clinical practice and tailor specific and appropriate treatment needs, allocation, intensity, intervention plans and rehabilitative programs (FIPP; Gannon et al., 2012).

Custodial

The scientific and empirical evidence presented from the use of second-generation actuarial tools may support the Department of Corrections with offender management decisions. Actuarial tools may assist with classification, supervision, access to working huts and the subsequent release back into the community. Newly developed offence-specific actuarial risk assessments such as the Edwards and Grace (2014) tool may complement and support other existing generalist second-generation actuarial tools such as the RoC*RoI (Bakker et al., 1999) which is currently in use by the NZ Department of Corrections. Risk assessments may also assist in the decision-making processes for determining involuntary detention to reduce the risk of future harm caused by firesetting (Watt & Ong, 2016).

Parole

Second-generation arson actuarial tools may assist with providing firm defensible, transparent and valid recommendations to tribunals, panels and parole boards for potential

arson parolees. These recommendations which are based on scientific empirical evidence presented in this thesis may support intensive monitoring, supervision, and stricter parole conditions for those identified as "high-risk". Expert advice in this field may provide defensible decisions at parole board hearings. Therefore, risk assessments may be utilised for the decision-making processes for potential release from prison (Watt & Ong, 2016).

Investigations

Second-generation actuarial tools may assist with providing consultation and subject matter expertise to local investigators and analysts who are prioritising and rank-ordering suspects in historical and unsolved arson cases. Actuarial tools may support and aid other screening initiatives such as the Bushfire Arson Target Screening (BATS; Bennett et al., 2010). Identifying risk factors for arson recidivism may also support and aid psychological profiling (Edwards & Grace, 2006) and the circle theory of environmental range (Canter & Larkin, 1993). Further, evidence-based risk assessments may assist Police officers in the management of paroled or bailed arson offenders (refusing bail, memorandums to Prosecutors and subject matter expertise to defence counsels) and guide bail conditions such as; not to enter or remain near any parks or reserves, not to carry or possess any flammable liquids or incendiary devices (lighters and matches). Actuarial tools may also provide subject matter expertise in parliamentary inquiries and Royal Commissions relating to bushfires and or critical incidents involving bombings and explosives.

Overall, the work conducted in this thesis impacts public health and safety, national security, the judicial system and the rights and liberties of those convicted of arson. Fortunately, Edwards and Grace (2014) developed evidence based second-generation predictive model and second-generation actuarial risk assessment tool for NZ arson offenders. In doing this,

the authors promote transparency, aid third and fourth generation approaches to arson risk assessment and provide guidance in identifying and managing the high-end/high-risk individuals who have the propensity and proclivity for committing arson offences in the future.

Now that we have discussed some of the key studies in the arson literature, described recent work in the development of arson actuarial risk assessment tools and its operational benefit, it is important that we briefly discuss a relevant offender classification system by style and type. This is fundamental given that this thesis is centred around arson recidivists, therefore any classification system that attempts to describe and classify repeat or serial arsonists is pertinent and clearly warrants discussion. We will now review an internationally recognised classification system that neatly categorizes offenders by style and type and in this context; the serial, mass or spree arsonist.

Arson Classification by Style and Type

Arson is a unique crime that comes in a variety of flavours (Kelm, 2016) and whilst the vast-majority of arson offenders set "one-off" or single fires their criminal careers as an arson offender typically ends there. While others, being the small but highly persistent group of arsonists set multiple arsons in a distinct pattern or style. One of the most common typological differentiations that distinguish multiple acts of arson is made between serial, mass, and spree acts. These three distinctions are presented in Table 8. In defining the essential features for each of the three arson types, we will briefly review the adapted classification table by Douglas et al., (1986). For clarification, style may be a combination of;

number of victims, number of events, number of locations and cooling-off periods. For type this may include; single ("one-off"), double, triple, mass, spree or serial offender.

Table 8

Offender Classification by Style and Type

Style	Single	Double	Triple	Mass	Spree	Serial
Number of Victims	1	2	3	4+	2+	3+
Number of Events	1	1	1	1	1	3+
Number of Locations	1	1	1	1	2+	3+
Cooling-Off Period	N/A	N/A	N/A	N/A	No	Yes

Note. Adapted from Douglas et al., (1986).

The Serial, Mass or Spree Arsonist

The Serial Arsonist

This type of arsonist has been the subject to more attention and research than any other form or type of firesetting behaviour. As stated by Lewis and Yarnell (1951) repeat arson offenders are referred to as serial firesetters (Douglas, Burgess, & Ressler 1997). These repeat firesetters become increasingly destructive and life threatening towards entire communities. They alarm local residents and they overtax the limited resources of local law enforcement agencies (Douglas et al., 1997; Icove & Horbert, 1990). A concerning report is that serial arsonists on average set about 31 fires until they are eventually caught or apprehended (Sapp

et al., 1994). These findings provide a clear and distinct pattern of behaviour that emerges with serial arsonists.

Serial arsonists by definition are those individuals who are involved in a minimum of three or more separate firesetting episodes with emotional cooling-off periods between each of their arsons (Douglas et al., 1997; Higgins, 1990; Holt, 1994). These cooling-off periods may last for days, weeks or even years. The unpredictable gaps between each of their arson attacks together with the apparently random selection of property or victims, makes the serial arsonist a highly dangerous type of offender (Higgins, 1990). It must be noted that a serial arson act does not have a distinct motive for firesetting but they display certain patterns of firesetting behaviour. Although, most typically, serial arsonists fall into the revenge, excitement and extremist-motivated categories (Douglas et al., 1997). As presented in table 8, a serial arsonist typically targets three or more victims, they are involved in three or more events, at three or more different locations and have cooling-off periods between each of their arsons. Of interest, the two empirical studies presented in this thesis (chapters 2 and 3) primarily focus on arson recidivism which by definition best resembles serial arsonists and are least likely to be mass or spree arson offenders (as per the definition).

The Mass Arsonist

Mass arsons involves one arson offender who sets about four or more fires during a limited time and typically at the same location (Douglas et al., 1997). There are no cooling-off periods between each of the arson attacks unlike the serial arsonist. An example of a mass arsonist would be an individual who sets fires to each floor of a government building. A mass arsonist typically targets four or more victims over the one event and at the same location.

The Spree Arsonist

The spree arsonist sets two or more fires at separate locations, but all within the one event, i.e., arsons committed within a 24-hour timeframe. Again, there is no cooling-off period between each of the arson attacks (Douglas et al., 1997). An example of a spree arsonist is an individual roaming city streets, setting fires all night in conjunction with the "Hell's Night" of Halloween (Douglas et al., 1997). A spree arsonist typically targets two or more victims, over the one event and over two or more locations.

With reference to this arson classification guide and the Edwards and Grace (2014) study, there is a strong association between individuals who commit spree or mass type arsons (multiple arsons) and an elevated risk for arson recidivism. As will be discussed in the second chapter of this thesis, having more than one arson charge at their criterion hearing date is a significant risk predictor for arson recidivism. Multiple arsons are deemed as one of the key risk predictors for the Edwards and Grace (2014) actuarial model and is also identified by Field (20145) as a promising risk factor.

Summary

In this chapter we commenced by defining arson in its current legal form (Section 267 of the NZ Crimes Act 1961), we provided clarification on some of the key terms used throughout this thesis such as arson, deliberate firesetting, incendiary fires, suspicious fires and pyromania. We moved onto the arson problem and discussed the issue faced with in the US, UK, NZ and from here we provided a summary and analysis of the overall statistics of convicted arson offenders in NZ (NZ Ministry of Justice, 2019). Next, we moved into the field of risk assessment with reference to the four generational approach to risk assessment as

defined by Bonta (1996). We opened this section by discussing the unaided and unstructured clinical judgements of the 1950's (first-generation approaches). Then we progressed to the 1970's and discussed the second wave of risk assessments which focus on evidence-based approaches and actuarial designs using static risk factors to predict recidivism. We provide examples of second-generation risk assessments such as the Statistical Information on Recidivism (SIR; Nuffield, 1982), the Offender Group Reconviction Scale (OGRS v.3; Howard et al., 2009) and the NZ actuarial risk assessment measure of choice, the RoC*RoI model (Bakker et al., 1999).

We followed into the 1990's and discussed third-generation risk assessments which combine both static and dynamic risk factors in their assessment tools. We discussed several operationalised third-generation instruments such as; the Level of Service Inventory-Revised (LSI-R; Andrews & Bonta, 1995), the Youth Level of Service Case Management Inventory (YLS/CMI; Hoge & Andrews, 2001, 2002) and the HCR-20 (v.3) by Douglas et al., (2013). From here, we narrowed down to specific instruments and scales for arson and firesetting and discussed promising firesetting risk assessment tools; these include (but not limited to); the St Andrews Fire and Arson Risk Instrument (SAFARI; Long et al., 2014), the Northgate Firesetter Risk Assessment (NFRA; Taylor & Thorne, 2005), the Pathological Firesetters Interview (PFSI; Taylor et al., 2004), the Fire Interest Rating Scale and the Fire Setting Assessment Schedule (FIRS/FAS; Murphy & Clare, 1996), the Firesetting Risk Assessment Tool for Youth (FRAT-Y; Stadolnik, 2010), the Fire Setting Scale (FSS) and the Fire Proclivity Scale (FPS) by Gannon and Barrowcliffe (2012), the Behaviour Risk Tool (BRT; Dadswell, 2018) and the Bushfire Arson Target Screening (BATS; Bennett et al., 2010). We conclude this topic and touched on the most latest approach to risk assessment, fourth-generation risk assessments (CMI; Hoge & Andrews, 2001, 2002).

Now that we gained an understanding of the four approaches to risk assessment, we discussed an important model which complements this field and its overall purpose, the Risk Need Responsivity Model (RNR; Bonta & Andrews, 2007). We discussed the importance of the RNR model as one of the most influential models for guiding the assessment and treatment of offenders. We reviewed the three core principles of the RNR model: the risk principle, the need principle and the responsivity principle; general and specific (Bonta & Andrews, 2007). We conclude that the RNR model forms an important role with second and third-generation risk assessments and note that some of the best offender risk assessment tools are guided on this model (Bonta & Andrews, 2007).

In continuing with influential models, we moved towards firesetting theories and reviewed the Dynamic-Behavioural Theory of Firesetting (DBToF; Fineman, 1980) which describes juvenile firesetting as the result of a proposed firesetting formula = G1 + G2 + E. We discussed the social learning model proposed by Kolko and Kazdin (1986) and the Multi-Trajectory Theory of Adult Firesetting (M-TTAF; Gannon et al., 2012). On this, we discussed the M-TTAF's importance with other recently developed micro-theories, such as; the Firesetting Offence Chain for Mentally Disordered (FOC-MD; Tyler et al., 2014) and the Descriptive Model of Adult Male Firesetting (DMAF; Barnoux et al., 2015). We completed this topic by briefly discussing two UK treatment programmes guided by the M-TTAF; the Firesetting Intervention Programme for Prisoners (FIPP; Gannon et al., 2012) and the Firesetting Intervention Programme for Mentally Disordered Offenders (FIP-MO; Tyler et al., 2018).

After reviewing these guiding models and influential theories we moved into the field of arson risk assessment and summarised the work of four key published researchers who have

developed predictive models for arson and firesetting recidivism (Rice & Harris, 1996; Edwards & Grace, 2014; Field, 2015; Ducat et al., 2015). Extending on their work, two authors developed empirically based actuarial risk assessment tools suitable for operational use within the wider population of arson offenders in NZ and in England/Wales (Edwards & Grace, 2014; Field, 2015). To conclude this topic, we explored the scope of arson recidivism and arson risk factors in the literature. This work covered multiple jurisdictions, varying samples and sample sizes from psychiatric, forensic and criminal justice settings, mentally disordered to criminally responsible arson offenders and with varying recidivism rates (2% to 49%) and with varying follow-up periods (6-months to 20-years). To conclude this topic, we provided a summary and discussion on how the relevant studies inform and guide our current research in this thesis (see chapters 2 and 3).

Our last topic in this literature review was a brief discussion on arson classification by style and type, such as; the serial, mass or spree offender (Douglas et al., 1997). This topic is pertinent to this thesis given the focus on arson recidivism and repeat arson offenders. Therefore, any classification system that attempts to describe or categorise repeat and serial arson offenders is fundamental to this thesis and is worthy for discussion.

Now that we have provided a review of the literature on risk assessment, arson recidivism and its risk factors as discussed by leading researchers in the arson field, we will progress onto the next chapter and present the published work by Edwards and Grace (2014). This empirical piece of research forms the complete basis of chapter two. Chapter two is the published Edwards and Grace (2014) journal article which forms a pivotal section of this thesis, the published article is titled “The development of an actuarial model for arson recidivism”.

The Aims for Chapter 2

- The aim of the second chapter was to extend on the previous work conducted by Rice and Harris (1996) on mentally disordered firesetters and develop and validate empirically based predictive models for arson, violent and non-violent recidivism among the wider population of convicted NZ arson offenders.
- A secondary aim of this chapter was to identify, compare and discuss the final static risk predictors associated with arson, violent and non-violent recidivism.
- A third aim of this chapter was to use the three risk predictors generated from the arson predictive model and develop and validate a second-generation actuarial risk assessment tool for arson recidivism.

The Research Questions for Chapter 2

Chapter two canvasses all four foundational and critically important questions which are explored and discussed throughout this thesis. The four important research questions we intend to investigate are:

1). Can actuarial tools be created to predict rare offending events such as arson offending?

The overarching goal of chapter two is to develop an actuarial model and risk classification scale to aid the prediction of arson recidivism in a New Zealand context. The work discussed in this chapter includes the Edwards and Grace (2014) actuarial model which is based on a second-generation approach for predicting arson recidivism. One of the main goals of the

Edwards and Grace (2014) study was to develop and provide a simple, user-friendly and automatically scored operationalised risk classification tool for NZ convicted arson offenders.

2). Are individuals who commit arson qualitatively different from individuals with non-arson criminal histories?

One of the primary goals of chapter two was to develop predictive models for arson recidivism and compare it with predictive models for violent and non-violent recidivism. In doing this we will assess and determine whether the final risk predictors used to generate the arson model are different from the final risk predictors used to generate the violent and non-violent models. As will be discussed in chapter two, based on the different risk predictors for each developed model, the authors were able to confirm that individuals who were repeat arson offenders were somewhat qualitatively different from individuals with non-arson criminal histories (Edwards & Grace, 2014; Rice & Harris, 1996). These conclusions will be discussed in more detail in chapter four.

3). To what degree should individuals who commit arson be assessed, managed and treated uniquely in the criminal justice system?

As will be discussed in chapter two and throughout the thesis, the expectation from the authors (Edwards & Grace, 2014) is that their developed actuarial tool will support practitioners and clinicians in identifying and assessing high-risk arson offenders. The work presented in chapter two will aid the decision-making and senior management processes for appropriate risk assessment, supervision and security classification of high-risk arson offenders in the criminal justice system. Of note, given that the Edwards and Grace (2014)

actuarial model is built on a second-generation approach (static risk factors only) its primary use is to conduct a preliminary risk assessment with the goal of identifying at-risk arson offenders. Ultimately, the Edwards and Grace (2014) model provides a long-term view of future risk for arson offenders in the criminal justice system.

The developed actuarial model by Edwards and Grace (2014) was not specifically designed identify the criminogenic needs and dynamic risk factors of an offender for treatment and rehabilitation within the correctional setting. As previously discussed, this type of work is more pertinent with third and fourth generation risk assessment approaches. Although, the actuarial tool presented in chapter two (if combined with third and fourth generation instruments) will guide appropriate case management for treatment allocation, intensity, intervention and rehabilitative programmes for arson recidivists.

4). How can arson actuarial tools be used and who would benefit from using them?

It is proposed that this type of research and the actuarial tool developed by Edwards and Grace (2014) will be of practical and operational benefit both Nationally and Internationally within the field of arson risk assessment. The work presented in chapter two is intended to provide valid, accurate and justifiable risk assessment tools which may be used within the multiple sectors of the criminal justice system, such as; judicial, treatment, custodial, parole and investigations. These important practical and operational implications are further discussed in chapter four.

CHAPTER TWO[2]

2. THE DEVELOPMENT OF AN ACTUARIAL MODEL FOR ARSON RECIDIVISM

ABSTRACT

To develop an actuarial model for arson recidivism, we studied individuals who were convicted of an arson-related offence between 1985 and 1994 in NZ (*n* = 1250). Over a 10-year follow up, recidivism rates for arson, violent and general offending were 6.2%, 48.5% and 79.3%, respectively. A cross-validation strategy was used where predictive models for arson, violent and non-violent recidivism were developed with Cox regression on a random half of cases, while the other half was used to test the models. Results showed that the model significantly predicted arson recidivism in the validation sample (AUC = .68): Offenders who were under 18-years old, had multiple arsons at the criterion hearing date and more prior vandalism offences were more likely to commit another arson. Results suggest that different variables predict arson compared to violent and general recidivism and support the use of actuarial models to identify high-risk arson offenders.

Key words: actuarial model; arson; firesetting; offender; predictor variables; recidivism; risk assessment; static risk factors.

[2] Edwards, M.J., & Grace, R.C. (2014). The development of an actuarial model for arson recidivism. *The Psychiatry, Psychology and Law*, *21*(2), 218–230.

INTRODUCTION

Arson is a dangerous crime that causes property damage, injury, loss of life and rates of deliberately set fires are increasing around the world (Chen, Arria, & Anthony, 2003; Prins, 1995). On a per capita basis, both the United States and Canada have among the worst fire problems in the world (Quinsey et al., 1998) and arson has ranked among the top three leading causes of fires in countries as diverse as NZ, Great Britain, Finland and Denmark (Geller, 1992). These findings underscore the need for further knowledge of arson and related firesetting behaviour so that effective interventions can be provided (Davis & Lauber, 1999). Despite the importance of this goal, relatively little is known about arsonists compared to other types of offenders, such as violent offenders and sexual offenders (Gannon & Pina, 2010).

However, there has recently been a surge of interest by researchers in arson (e.g., see the special issue of *Psychiatry, Psychology and Law*; McEwan & Freckelton, 2011), and new theoretical perspectives have been advanced to explain firesetting behaviour (Gannon et al., 2012). The goal of this current study was to develop an actuarial model for arson recidivism, and to determine whether predictors of arson recidivism were different from those for violent and general (i.e., non-violent) recidivism.

How likely are arsonists to reoffend by setting another fire? Several studies have reported recidivism rates for arsonists, which are generally low relative to comparable rates for violent and general offenders. Soothill et al., (2004) found that rates of arson recidivism during a 20-year follow-up more than doubled from 1951 to 1980, from 4.5% to 10.7%. Soothill et al., (2004) noted that there was a minority of persistent arson offenders that could potentially be

identified. These results corroborate earlier research by Sapsford et al., (1978), who identified that about 6% of arsonists released from prison would commit additional arsons within three years. Despite these low rates, arson recidivism in the literature does vary considerably between 4% to as much as 60%, depending on the type of firesetter. For example, mentally disordered firesetters have higher rates of recidivism than non-mentally disordered firesetters (Lindberg et al., 2005). Heterogeneity in arson recidivism rates reported across studies has also been attributed to different populations, study designs and sample biases (Brett, 2004).

What are the risk factors for arson recidivism? Kennedy et al., (2006) reviewed the firesetting literature with the aim of identifying predictors of recidivism for young offenders. One of the major variables identified was previous firesetting behaviour, which emerged as a strong predictor of future arsons (Brett, 2004; Quinsey et al., 1998; Rice & Harris, 1996; Sapsford et al., 1978). In addition, Kennedy et al. (2006) found that compared to non-recidivists, recidivists had greater levels of fire interest and fire-related activities and were more likely to be male and older. Jayaraman and Frazer (2006) examined 34 pre-trial arson court reports between 1999 and 2003 and identified that 23 cases had previous firesetting histories, which ranged from special interest to firesetting recidivism to pyromania. Seven cases were assessed at very high-risk for re-offending while 27 were low to moderate risk.

An important question has been whether mentally disordered firesetters represent a distinct subtype of arsonists. Barnett et al., (1997) found that mentally disordered firesetters have higher rates of arson, higher rates of arson relapse and committed fewer common offences than the non-mentally disordered arsonists. Thus, their results suggest that mentally disordered arsonists generally do not have extensive criminal careers but are prone to committing fire-related offences. Rice and Harris (1996) investigated the recidivism of 208

mentally disordered firesetters and found that over a 7.8-year follow up, 16% committed another fire, 31% a violent re-offense, 57% a non-violent re-offense and 66% committed some type of recidivism. The results further indicated that the variables significantly associated with firesetting recidivism were different from those that predicted violent and non-violent recidivism. Rice and Harris (1996) developed a multivariate equation to predict recidivism for mentally disordered firesetters, which included variables such as, age at first firesetting and firesetting history. These results are consistent with the earlier literature on arson recidivism and provide a good starting point for the development of a risk prediction tool for arsonists.

The major goal of the present study was to develop a second-generation, actuarial model for predicting arson recidivism among convicted arsonists. According to Bonta's (1996) terminology, first-generation risk assessments are those which are based on unaided clinical judgement. One of the features of this approach is that decisions are subjective and sometimes guided by "gut feelings" which are not empirically validated (Andrews & Bonta, 2003).

Second-generation risk assessment is based on empirical relationships between offence history variables known as static risk factors and future offending (Kim et al., 2008). Typical static risk factors include: Type of offence, prior criminal history, age, ethnicity, prior parole failure, gender, security classification, sentence length, risk interval and history of drugs. Overall, research has found that second-generation actuarial risk prediction tools consistently outperform unaided clinical judgments (Moran et al., 2001; Harris et al., 1993; Silver et al., 2000; Carroll et al., 1982).

An example of a second-generation instrument is the Statistical Information on Recidivism (SIR; Nuffield, 1982). Bonta et al., (1996) conducted a re-validation study of the SIR scale and found that it was a good predictor of general recidivism. Third-generation risk assessments are those which include dynamic risk factors such as criminal associates, alcohol and current drug use (Benda et al., 2001). Dynamic risk factors assist in predicting criminal behaviour and identify targets for intervention (Benda et al., 2001).

A popular third-generation instrument is the Level of Service Inventory-Revised (LSI-R) by Andrews and Bonta (1995). The LSI-R consists of 54 items that assess 10 areas of risk, these include, personal problems, substance abuse and criminal history (Benda et al., 2001; Loza & Loza-Fanous, 1999). Total scores are then classified into risk levels reflecting re-offending probabilities (Benda et al., 2001). Gendreau et al., (1996) conducted a meta-analysis and found that the LSI-R was the most useful measure of choice for predicting general recidivism (see also Campbell et al., 2009).

We planned to develop a second-generation actuarial model for predicting arson recidivism. To our knowledge, there has been no prior published study that has tested an actuarial model for arson recidivism among criminally responsible and non-mentally disordered offenders. In the present study, a 10-year follow-up was conducted on a comprehensive national sample of 1250 arson offenders in NZ. To be eligible for inclusion, an individual had to have been convicted of at least one arson offence between 1985 and 1994. The first arson offence that occurred between 1985 and 1994 was the criterion offence and was used to define a 10-year follow-up period during which all offending was recorded. As with the correctional literature on static predictors, the study relied on offence-history variables for the development of an actuarial arson risk prediction model. Our primary goals were to identify the variables

associated with arson recidivism and test whether they were different from those for violent and non-violent recidivism.

METHOD

Participants

We identified 1250 individuals who had been charged with at least one arson offence in NZ between 1985 and 1994. For each offender, the first such offence was defined as the criterion offence. For criterion offences, 1247 were convicted and 3 were detained. Arson is indicated by NZ Police offence codes 5111, 5112, and 5119, which refer to "wilfully damages property by explosives/endangers life by", "wilfully sets fire to property/endangers life by", and "other arson", respectively. Those convicted from youth courts were eligible, but all were required to be age 14-years or older at the time of their first arson offence. The study also included 46 individuals who passed away during the 10-year follow up; for these cases, the follow-up period ended on the date of their deceased date. Thus, the study sample comprised 1250 individuals, all of whom were judged to be criminally responsible for their arson offence/s at the time of their arson charges. For all arsons (including subsequent arson committed during follow-up), the Court outcomes did not identify any cases that were found not guilty by reason of insanity, acquitted insane or diminished responsibility.

Data Collection Procedures

Complete criminal history information was obtained for all cases from the National Intelligence Application (NIA) database maintained by the NZ Police. Our goal was to study

recidivism over a 10-year follow up period from a date after the criterion arson offence. For each case, the criterion date was the date of the first arson court appearance after the arson criterion offence. Recidivism was defined as a conviction or detainment for any offence that occurred during the 10-year follow up period. For offenders who had been given a term of imprisonment for their criterion offence, the end of the follow up was defined as 10-years after the criterion hearing date plus two-thirds of their sentence (as official prison release dates were not recorded and typically offenders would be eligible for parole at this time).

Arson recidivism was defined as a subsequent arson offence as discussed, for an offence which occurred after the criterion hearing date and prior to the end of the follow up. Violent recidivism was defined as a subsequent violent conviction against another person, such as murder, kidnapping, assault and aggravated robbery (and excluded all arson offences). Non-violent recidivism was recorded as any other criminal conviction not subsumed by the arson and violent definitions, such as vandalism, drug offences, shoplifting, driving offences and administrative breaches. Both violent and non-violent recidivism were noted when offences occurred after the criterion hearing date and prior to the end of the follow-up.

Potential predictor variables were obtained from the database. These were demographic and offence-history variables, and included age, number of previous convictions depending on offence type and characteristics of the criterion offence (e.g., wilfully damages property by explosives, wilfully sets fire to property, other arson and multiple arsons). Prior offence types included: Arson, violent, vandalism, theft, drug, sex, driving, other and all types of offences. Several of the count-based variables (e.g., number of prior violent offences) were positively skewed and were recoded for subsequent analysis (see Appendix B).

Data Analysis

The Kaplan-Meier method was used to develop survival curves for each type of recidivism during the 10-year follow up period. Pearson correlations using bivariate analyses were used to examine the relationship between potential static variables and arson, violent and non-violent recidivism. The sample was then randomly divided into developmental and validation subsamples (n = 625). Predictive models for arson, violent and non-violent recidivism were estimated based on the developmental sample using forward stepwise Cox regression in which a $p < .05$ criterion was used for entering predictors at each step. The predictive validity of each model was then tested using the validation subsample. The accuracy of all models was measured in terms of the area under the Receiver Operating Characteristic (ROC) curve (AUC; Rice & Harris, 1995).

Statistical analyses were conducted using SPSS (v. 18.0). Significance tests used the .05 level but obtained p values are reported to $p < .001$.

RESULTS

The sample comprised of 99.7% (n = 1246) males and 0.3% (n = 4) females. In terms of ethnicity, 64.4% (n = 805) were NZ European/Caucasian, 30.3% (n = 379) were NZ Māori, 4.4% (n = 55) were Pacific Islands/Polynesian and 1% (n = 11) belonged to other ethnic groups (Indian, Native African/African origin and Asian). The mean age at the criterion offence was 23.84 years (SD = 8.57) and ranged from 14.20 to 77.43 years. The mean age at the first arson offence was 23.34 years (SD = 8.48) and ranged from 14.07 to 77.15 years. Descriptive statistics for demographic and offence history variables are shown in Table 9. For

the criterion offence 3.68% (*n* = 46) had a 5111-arson conviction ("wilfully damages property by explosives/endangers life by"), 61.76% (*n* = 772) had a 5112 arson ("wilfully sets fire to property/endangers life by") and 37.60% (*n* = 470) had a 5119 arson ("other arson"). Offenders with more than one arson conviction at the criterion hearing date were 14.40% (*n* = 180) of the sample; for these, the average number of criterion arson convictions was 2.43 (*SD* = 1.01; minimum = 2; maximum = 9).

Table 9

The Descriptive Statistics for the Arson Cohort

Variables	Mean (*SD*)	Minimum	Maximum
Demographics			
Age at criterion	23.84 (8.57)	14.20	77.43
Age at first arson offence	23.34 (8.48)	14.07	77.15
Age at first offence	18.60 (5.79)	11.52	62.01
Offence History (Number of Prior Convictions)			
Arson	.00 (.113)	0	4
Violent	1.06 (2.08)	0	20
Vandalism	.69 (1.54)	0	26
Theft	7.54 (13.16)	0	221
Drug	1.46 (3.09)	0	44
Sexual	.09 (0.47)	0	7
Driving	1.16 (2.60)	0	31
Other	3.68 (4.19)	1	35
All	15.69 (19.02)	1	236
Survival Times (Days)			
Arson	1264.79 (1054.70)	0	3751
Violent	1378.30 (1082.01)	0	5225
Non-violent	659.45 (750.32)	0	5225

Note. Total *n* = 1246. Descriptive statistics for demographics, offence history (number of prior convictions) and survival times (in days) for the arson cohort.

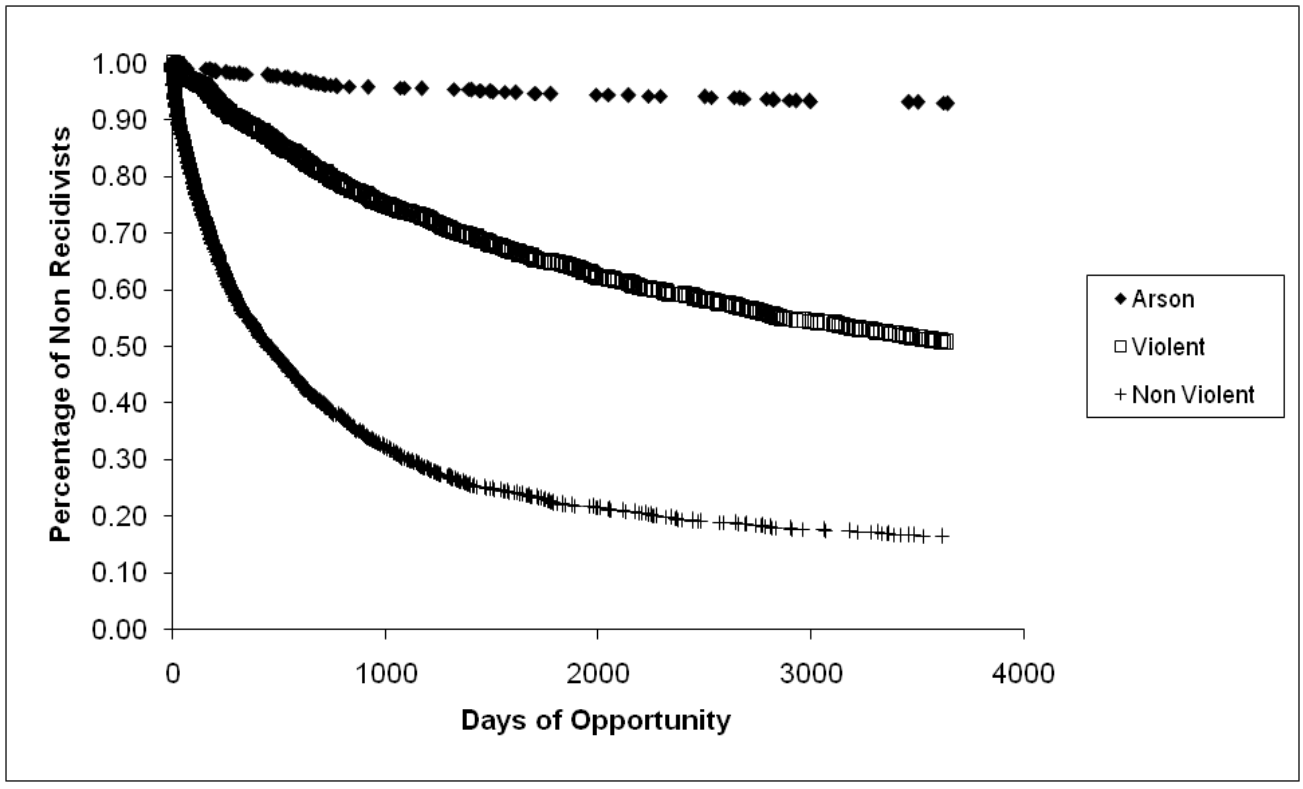
During the 10-year follow up period, 6.2% (n = 77) of the sample were convicted of a new arson offence, 48.5% (n = 606) were convicted of a new violent offence and 79.3% (n = 991) were convicted of a non-violent offence. Overall, 81.7% (n = 1021) of the sample committed a new offence of any type during follow-up. For those that reoffended, mean times to failure were 1264.79 days (SD = 1054.70) for arson recidivism, 1378.30 days (SD = 1082.01) for violent recidivism and 659.45 days (SD = 750.32) for non-violent recidivism. Figure 6 shows survival curves for each type of recidivism during the 10-year follow up using the Kaplan-Meier method. The survival curves confirm that the rate of arson recidivism was significantly lower than that for violent recidivism, χ^2 (df = 1) = 563.44, $p < .001$ and the rate of violent recidivism was lower than for non-violent recidivism, χ^2 (df = 1) = 256.96, $p < .001$.

Of note, the arson, violent and non-violent survival curves represent those individuals who committed a repeat offence of its kind following their respective criterion dates (first court hearing date following their index offence) for up to 10-years. Figure 4 provides a visual representation of those individuals who had reoffended and subsequently committed an arson, violent or non-violent-related offence during their 10-year follow-up (days of opportunity), otherwise known as "at-risk" time to reoffend. The figure presents that the percentage of non-recidivists range from 0 to 1.0 on the scale. For example, if the survival curve were at a flat line at 0 (y-axis) and across the 10-year duration (x-axis) this would indicate that the whole sample were recidivists (all individuals had reoffended at some point time during the 10-year tracked period). Alternatively, if the survival curve were at 1.0 (y-axis) and across the 10-year duration (x-axis) this would indicate that the whole sample were non-recidivists (no individuals committed any type of offences of its kind during the recorded 10-year period). A preliminary inspection of the survival curve indicates that the arson recidivism curve is close to 0.94 (percentage of non-recidivists), this would indicate that the vast majority of the

sample were non-arson recidivists. This is matched by the recidivism rate which provided 6.2% (*n* = 77/1250) of arsonists had committed a subsequent arson offence during the follow-up period. The survival curve for violent recidivism is close to 0.52, this would indicate that about half of the sample had recommitted a violent offence (48.5%, *n* = 606/1250). Last, the survival curve for non-violent recidivism is close to 0.2, this would indicate that over three-quarters of the sample had recommitted a non-violent offence (79.3%, *n* = 991/1250).

Figure 4

The Survival Curves for Arson, Violent and Non-violent Recidivism



Note. Total *n* = 1250. The Kaplan-Meier method was used to develop the three survival curves. The arson, violent and non-violent survival curves were based on the recidivism data obtained over the individuals 10-year follow-up.

Table 10 presents the correlations between demographic and offence history variables and the three types of recidivism for the developmental sample. Six variables were significantly

correlated with arson recidivism: First arson < 18-years, multiple arsons and the number of prior arsons, vandalism, violent/vandalism and theft/vandalism offences. Offenders who had committed their first arson prior to 18-years of age, had multiple arson convictions for the criterion offence and more prior arsons, vandalism, violent/vandalism and theft/vandalism offences were more likely to commit an additional arson offence during follow up.

However, the magnitude of the correlations was relatively small (the largest, for multiple arsons, was $r = .12$, lowest for first arson < 18-years, number of prior arson and theft/vandalism offences was $r = .06$). Variables significantly related to violent recidivism were: Ethnicity (offenders of NZ Māori or Pacific Islands ethnicity were more likely to reoffend violently), first arson < 18-years, age at first arson offence, first offence < 18-years, age at first offence and number of prior offences (violent, vandalism, theft, violent/vandalism, theft/vandalism, drug, driving, other and all prior offences). Predictors of non-violent recidivism were: Ethnicity (NZ Māori/Pacific Islands), first arson <18-years, age at first arson offence, first offence < 18-years, age at first offence and number of prior offences (violent, vandalism, theft, combination of violent/vandalism, theft/vandalism, drug, driving, other and all prior offences).

Overall, Table 10 presents offence history variables predicting recidivism, but that correlations were overall stronger for violent and non-violent recidivism than for arson recidivism. The reduced magnitude of the correlations for arson recidivism likely reflects the lower base rate (6.2%) compared with violent and non-violent recidivism, which had higher base rates (48.5% and 79.3%, respectively).

Table 10

Correlations Between Static Variables and Arson, Violent and Non-violent Recidivism from the Developmental Subsample

Static Variables	Arson	Violent	Non-violent
Demographics			
NZ Māori/Pacific Islands	-.05	.20**	.15**
First arson < 18-years	.06*	.10**	.08**
Age at first arson offence	.04	.15**	.16**
First offence < 18-years	.04	.25**	.22**
Age at first offence	.04	.27**	.27**
Criterion Offence Types			
Wilfully damages property by explosives (5111)	-.01	-.05	-.08**
Wilfully sets fire to property (5112)	.02	-.02	-.01
Other arsons (5119)	-.02	.00	.05
Multiple arsons	.12**	-.01	.00
Number of Prior Offences			
Arson	.06*	-.04	-.03
Violent	.04	.26**	.14**
Vandalism	.10**	.15**	.08**
Theft	.02	.26**	.28**
Violent/vandalism	.09**	.24**	.13**
Theft/vandalism	.06*	.27**	.25**
Drug	-.01	.19**	.16**
Sex	.02	.05	-.04
Driving	-.04	.08**	.15**
Other	.02	.18**	.16**
All	.05	.27**	.27**

Note. *$p < .05$; **$p < .01$. This table is based on the developmental subsample ($n = 625$).

A major goal of the present study was to develop a predictive model for arson recidivism and compare it with predictive models for violent and non-violent recidivism (full results, see Appendix D). For this, we used a stepwise survival analysis (Cox regression) in which the

predictors were entered into a model with a $p < .05$ criterion for inclusion at each step. The final predictors included in the model for each type of recidivism are presented in Table 11. The model for predicting arson recidivism included three significant predictors: First arson < 18-years, multiple arsons and number of prior vandalism offences. Those offenders who; were young at the time of the criterion arson offence, had multiple arson counts and more prior vandalism offences had a significantly greater rate of arson recidivism. In terms of odds ratios (OR), the strongest risk factor were multiple arsons for the criterion offence (OR = 3.27). Under 18-years old and number of prior vandalism offences were associated with odds ratios of 2.51 and 1.41, respectively.

The models for violent and non-violent recidivism are presented in Table 11. For violent recidivism, significant predictors included: first arson < 18-years, age at first offence, number of prior violent and prior all offences. The strongest predictors in terms of odds ratios were first arson < 18-years and age at first offence, which were associated with 53% and 50% unit increases in the relative rate of violent recidivism, respectively. For non-violent recidivism, the significant predictors were age at first arson, number of prior theft and prior drug offences. The strongest predictor in terms of odds ratio was age at first arson, which was associated with a 40% unit increase in the relative rate of non-violent recidivism.

Table 11

Predictor Variables for the Arson, Violent and Non-violent Models from the Developmental Subsample

Predictor Variables	*B*	Exp(*B*)
Arson Model		
First arson < 18-years	0.92**	2.51
Multiple arsons	1.18***	3.27
Number prior vandalism	0.34*	1.41
Violent Model		
First arson < 18-years	0.42**	1.53
Age at first offence	0.40***	1.50
Number prior violent	0.32***	1.37
Number prior all	0.19**	1.21
Non-violent Model		
Age at first arson	0.33***	1.40
Number prior theft	0.22***	1.24
Number prior drug	0.12**	1.13

Note. $*p < .05$; $**p < .01$, $***p < .001$. This table is based on the developmental subsample ($n = 625$).

We computed the area under the Receiver Operating Characteristic curves (AUC) as a measure of predictive accuracy. The AUC values for the models predicting arson, violent, and non-violent recidivism were .70, .72 and .75, respectively. This shows that the models achieved reasonably good levels of predictive validity.

To assess the generalizability of each prediction model a cross-validation strategy was employed in which the 1250 cases were randomly divided into two separate subgroups. The first subgroup or developmental sample ($n = 625$) was used to develop the best predictive models for arson, violent and non-violent recidivism. The second subgroup or validation

sample (n = 625) was used to test the generalizability of the three prediction models. Using the model parameters (coefficients) from the developmental sample XBeta calculations were conducted to produce scores used to predict recidivism in the second group (validation sample).

Table 12 presents the AUC values for predicting arson .70, violent .72 and non-violent .75 recidivism in the developmental subsample (at the $p < .001$ level). Also, the table presents the AUC values for predicting arson .68, violent .72 and non-violent.73 recidivism in the validation subsample (at the $p < .001$ level). Of note, the whole sample (n = 1250) was divided into developmental and validation subsamples prior to calculating the AUC values presented in table 12. The cross-validation study identified a .02 decrease in AUC values for the arson and non-violent predictive models and a match for the violent model. Overall, this providing additional support for the accuracy of all three developed models, especially the violent model. The AUC findings successfully generalize the models from an independent set of cases.

To provide a measure of the degree of overlap between predictors of arson, violent and non-violent recidivism, we examined correlations between XBeta scores for the three models. XBeta scores correspond to predicted raw scores in multiple regression and provide a standardized measure of the risk associated with individual cases (positive values associated with higher predicted risk, negative values with lower risk and zero with average risk) and all correlations significant at the $p < .001$ level. The correlation between XBeta values predicted by the arson and violent models was r = .43 and the corresponding correlation between arson and non-violent scores was r = .36. By contrast, the correlation between XBeta scores predicted by the violent and non-violent models was r = .74. These results show that there is

greater overlap between the predictors of violent and non-violent recidivism, than between either violent or non-violent and arson recidivism.

Table 12

The AUC Results for the Developmental and Validation Subsamples for the Arson, Violent and Non-violent Models

Model	AUC Score	95% CI	
		Lower	Upper
Arson (Developmental)	0.70***	0.62	0.78
Arson (Validation)	0.68***	0.60	0.77
Violent (Developmental)	0.72***	0.68	0.76
Violent (Validation)	0.72***	0.68	0.76
Non-violent (Developmental)	0.75***	0.70	0.79
Non-violent (Validation)	0.73***	0.68	0.78

Note: ***$p < .001$. Total $n = 625$ (Developmental subsample); $n = 625$ (Validation sub-sample). CI = confidence interval; *LL* = lower limit; *UL* = upper limit.

Finally, we constructed an actuarial model for predicting arson recidivism from a sample of convicted arson offenders. Three statistically significant variables provided the best predictive model for arson recidivism; first arson < 18-years, multiple arsons and the number of prior vandalism offences. To generate a risk scale based on the actuarial model, a simple ten-point scale was developed using the beta weights from the three predictor variables in the model; first arson < 18-years (coded from 0-3), multiple arsons (coded from 0-5), and vandalism (coded from 0-2). The three predictor variables for the 10-point risk scale are coded as described above. Each of the three variables were binary (for example, if first arson < 18-years then coded as +3, otherwise 0; if multiple arsons then coded as +5, otherwise 0; if

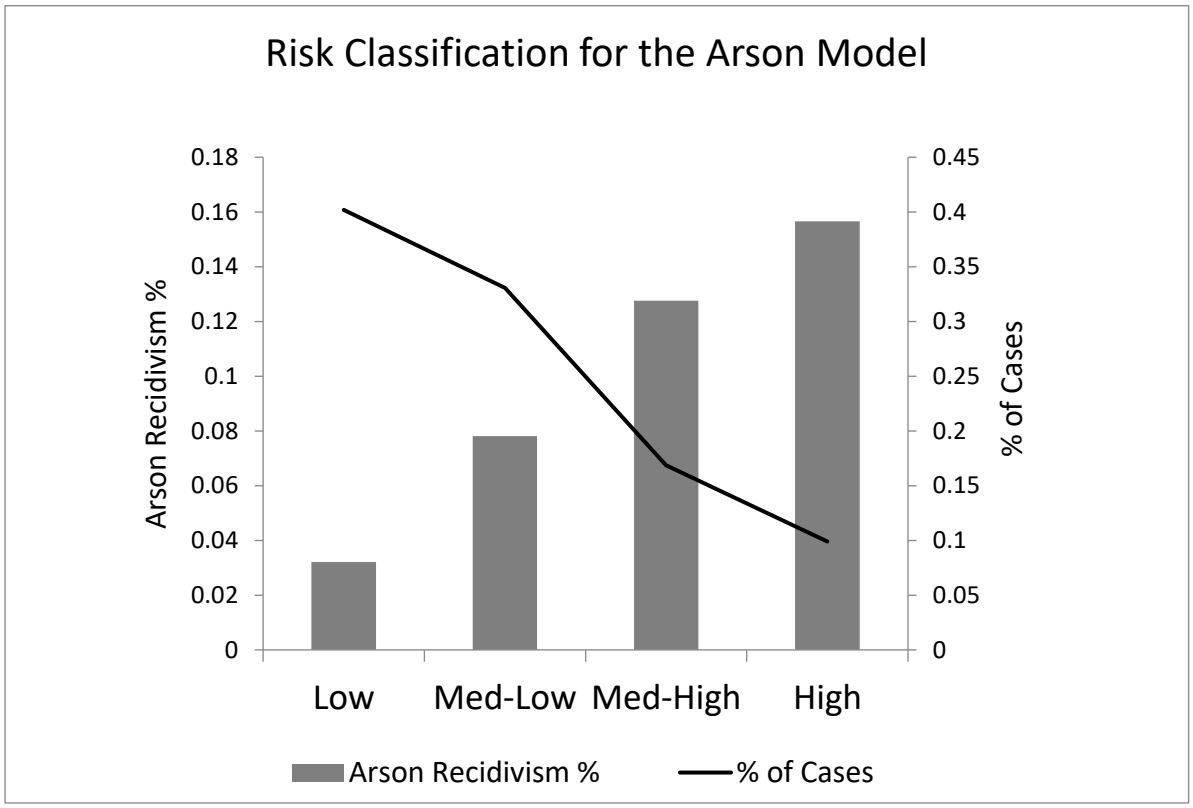
vandalism then coded as +2, otherwise 0). Of note, the recoding of variables in Appendix B were those that the authors used to generate the predictor variables for the Cox regression analyses.

The defined risk scale varied from 0 to 10, with lower risk scores indicting low-risk and higher risk scores reflecting high-risk for arson recidivism. To develop a simple risk classification based on the risk scale, we constructed four risk bands using the sum of the model scores from the sample: Low (0-1), Medium-Low (2-3), Medium-High (4-6) and High (7-10). These risk scores were based on the sum of the three predictor variables in the actuarial model; first arson < 18-years, multiple arsons and the number of prior vandalism offences.

Figure 5 presents the proportion of recidivism against the percentage of the sample. The percentage of the sample (arson recidivism %) in the four risk bands were: 3%, 8%, 13% and 16% for low, medium-low, medium-high and high, respectively. The figure displays the percentage of the sample increasing as the risk bands increase from low to high. Further, the proportion of recidivism (% of cases) decreased monotonically from: 40%, 33%, 17% and 10% for low, medium-low, medium-high, and high, respectively. The figure presents the proportion of recidivism decreasing as the risk bands increase from low to high. The AUC for the 10-point actuarial scale for predicting arson recidivism in the full sample (n = 1250) was .67.

Figure 5

Risk Classification and Recidivism Rates for the Arson Model



DISCUSSION

The primary goal of the present study was to develop an actuarial model for predicting arson recidivism. We identified a sample of 1250 individuals who represented all those who were convicted of an arson offence between 1984 and 1995 in NZ. The sample was followed up for a period of 10-years and subsequent offences were recorded. During the follow-up, 6.2% of the sample were convicted of a new arson offence; recidivism rates for violent and general (i.e., non-violent) recidivism were 48.5% and 79.3%, respectively. Cox regressions were used to generate predictive models for arson, violent and non-violent recidivism; these were based on a random half of the 1250 sample (developmental subsample). The predictor variables selected for the arson model were; first arson < 18-years, multiple arsons and prior vandalism

offences. These findings suggest that arsonists who were younger at the time of their criterion offence, had more than one arson charge in their court hearing for their criterion offence and had more prior vandalism offences were significantly more likely to commit an arson offence in the future.

Our findings are similar to the Rice and Harris (1996) multivariate prediction equation which relied heavily on the age at first firesetting and history of firesetting. These results further support a review conducted by Kennedy et al. (2006) that previous firesetting behaviour was the best single predictor of future firesetting behaviour. Sapsford et al. (1978) further identified the single best predictor for arson re-offending was the number of previous arson convictions. Thus, those few arsonists with a history of arson offending are likely to be among the few that commit further arsons after release from prison (Sapsford et al., 1978).

The findings from this present study adds to the existing literature on arson recidivism which provides support for the development of a risk prediction model for convicted arsonists. Consistent with the results reported by Rice and Harris (1996), this study further identified that the variables used to predict arson recidivism were different from those variables used to predict violent and non-violent recidivism. The pattern of correlations between the arson, violent and non-violent recidivism models suggests that the act of arson is different to both violent and non-violent offending.

Using the same model parameter values and coefficients from the developmental subsample, the arson, violent and non-violent models accurately predicted recidivism for the remaining half of the cases (validation subsample). The AUC values for predicting recidivism in the developmental subsample (n = 625) was arson .70, violent .72 and non-violent .75 ($p < .001$).

The AUC values for predicting recidivism in the validation subsample (n = 625) were arson .68, violent .72 and non-violent.73 (at the $p < .001$). The cross-validation study identified similar AUC levels were obtained for the developmental and validation subgroups and so the models were robust and generalized well to an independent sample. The levels of accuracy for the arson model are somewhat higher than the average accuracies reported in the second and third-generation instruments found in Schwalbe's (2008) meta-analysis (AUC = .64 and .65, respectively).

Based on the Cox regression model, we developed a simple 10-point risk classification scale that could be used in practice to assess arson offenders and identify high-risk cases for firesetting recidivism. The scale defined four risk bands (low, medium-low, medium-high, and high), which included 3%, 8%, 13% and 16% of the sample, respectively. Across bands, the risk of arson recidivism decreased monotonically from 40% (low) to 10% (high) with AUC = .67. Given that the input variables for this model are derived solely from static variables in a computer database, it would be suitable for automatic scoring purposes (see. Skelton, Riley, Wales, & Vess, 2006). The availability of a simple, automatically scored classification instrument for arson offenders would have practical benefits, including, identifying subgroups of arsonists; identifying specific risk factors associated with arson recidivism and supporting the decision-making process for appropriate intervention, supervision and security classification of high-risk arson offenders.

It is of interest to compare the recidivism rates from the present study for with those of previous studies including Rice and Harris (1996) and Sapsford et al. (1978). For the present sample, recidivism rates (arson 6.2%; violent 48.5%; non-violent 79.3%; any offence 81.7%) showed a different pattern than Rice and Harris (1996), who reported that 16% of their

sample committing another arson offence, 31% a violent re-offense, 57% a non-violent re-offense and 66% committed any new offence. Arson recidivism rates in our study were relatively low compared to Rice and Harris (1996), who studied mentally disordered firesetters, however, the rates of violent and non-violent recidivism were higher in this sample. The relatively low recidivism rate for arson in this study is consistent with Sapsford et al. (1978), who identified only about 6% of arsonists were later convicted of setting a new fire, although their study was based on a shorter follow-up period (3-years vs 10-years). Although overall rates of arson recidivism are relatively low, there is a minority of persistent offenders (Soothill et al., 2004) and given the high costs associated with arson, the use of actuarial models for screening such offenders is highly warranted and worthy of additional exploration.

The most likely reason for the difference in recidivism rates between this study and the Rice and Harris (1996) study is that we used the full population of arson offenders during the study period, all of whom were judged criminally responsible, whereas Rice and Harris (1996) sample consisted of 243 firesetters who were admitted to a maximum-security division of a psychiatric facility. Some of whom were remanded for psychiatric evaluations (48%), some admitted without criminal charges (33%), some found not guilty by reasons of insanity (12%) and only a few subjects (6%) were admitted for treatment at serving correctional institutions. The relatively low rate of recidivism in this sample suggests that for most offenders with arson convictions, firesetting is a ‘one-off’, an offence that they may commit during the course of their criminal careers, but otherwise have no disposition towards. However, the success of the actuarial model suggests that offenders with a relatively high risk of arson recidivism can be identified (see Figure 5).

A limitation of the present study is that this model (like most actuarial models) was based entirely on static variables such as number of previous offences. Our model does not incorporate any dynamic risk factors that might be linked to arson recidivism and which are commonly included in third-generation risk assessments such as the Violence Risk Scale (VRS; Wong & Gordon, 2006). Thus, our model is unable to provide any valuable information regarding treatment targets or how risk can be mitigated. To increase the effectiveness and utility of offender risk assessment, incorporating both static and dynamic risk variables into a more comprehensive model may further advance risk assessment for arson offenders. The static risk factors identified here can provide a basis for third-generation model development.

In summary, we developed an actuarial model for predicting arson recidivism. Our findings are consistent with the relatively few prior studies on arson recidivism and suggest the feasibility of an automatically scored model which can aid in the identification of high-risk offenders among arsonists who are judged as criminally responsible. An important goal for future research will be to extend this model by including dynamic risk factors. It will be important to determine whether dynamic risk factors for arson recidivism are different from those associated with violent and non-violent offending.

The statements and opinions expressed in this research are those of the authors and do not necessarily represent the views of the NZ Police.

CHAPTER THREE

3. REPLICATING THE EDWARDS AND GRACE (2014) STUDY

ABSTRACT

The purpose of the present study was to test the generalizability and utility of the Edwards and Grace (2014) arson actuarial model across a different and non-overlapping NZ sample of convicted arson offenders. To achieve this goal, the authors replicated the original Edwards and Grace (2014) study and built additional predictive models for arson, violent and non-violent recidivism and developed a second preliminary arson actuarial tool. The authors obtained a new arson cohort series of 1464 convicted arson offenders, a random sample of 1464 violent offenders and a random sample of 1464 non-violent offenders between 1998 and 2008. Over a 5-year follow up, 5.87% of the arson cohort committed a new arson; 28.21% committed a new violent offence and 59.02% committed a new non-violent offence. For the violent sample, 51.02% committed a new violent offence and 65.23% committed a new non-violent offence. For the non-violent sample 31.76% committed a new violent offence and 72.47% committed a new non-violent offence.

Logistic regression was used to generate the best fitting predictive models for each recidivism group. Final predictor variables for the arson predictive model were; first arson under 18-years and number of prior arson offences. For the violent model (violent recidivism); age at first violent offence, age at first offence under 18-years and number of prior vandalism offences. For the non-violent model (non-violent recidivism); age at first offence and age at first offence under 18-years. We were able to conclude that prior offence history variables were different between the arson and violent predictive models and that no prior offences

made inclusion for the non-violent model. The AUC scores generated for each of models were .61, .66 and .75, respectively. These findings suggest that the variables used to predict arson recidivism and violent recidivism provided a moderate level of predictive accuracy whereas the non-violent model provided a high level of predictive accuracy. Next, we replicated the Edwards and Grace (2014) actuarial risk-classification tool for high-risk arson offenders. We employed the same methodology and relied on the same three final risk predictors used in the Edwards and Grace (2014) study to develop the actuarial tool. The findings indicate that the predictive accuracy for both empirical studies in this thesis was higher in the original study compared to this current study, AUC = .68 vs AUC = .61, respectively.

Last, we conducted linear discriminate analysis for this current arson cohort against a sample of violent offenders and non-violent offenders. The results confirm that we cannot successfully differentiate or classify the three groups of offenders between each other, particularly for arson and violent offenders. Thus, attempting to identify arson and violent groups were at levels lower than by chance. Therefore, individuals who commit an arson offence are not qualitatively different or unique from individuals with non-arson criminal histories, such as violent offenders and non-violent offenders. This distinction was solely based on individual's prior offence histories and no other risk predictors were used for this test.

Overall, the results from the Edwards and Grace (2014) study and the current study both support the use of actuarial risk assessment tools for identifying high-risk arson offenders. This replicated study adds to the generalizability and utility of the Edwards and Grace (2014) actuarial tool across different arson cohort series and may provide additional scope and

direction for use within the criminal justice system. Although, limitations of this present study are acknowledged and addressed by the authors, these do not impact the overall findings and practical implications of this work.

As previously discussed, this chapter comprises of the same overarching aims in the original Edwards and Grace (2014) study.

The Aims of this Chapter

- The aim of this third chapter is to assess the generalisability and utility of the original Edwards and Grace (2014) tool. To achieve this, we developed additional empirical based predictive models for arson, violent and non-violent recidivism among convicted NZ arson, violent and non-violent offenders.
- A secondary aim of this chapter was to identify, compare and discuss the final static risk predictors associated with arson, violent and non-violent recidivism.
- A third aim of this chapter was to replicate the Edwards and Grace (2014) actuarial tool and build an additional second-generation actuarial risk assessment tool for arson recidivism.
- A fourth aim of this chapter was to identify whether we can accurately classify and distinguish between a group of arson offenders from a group of violent and non-violent offenders and vice versa. Of note, this test was not administered in the first arson cohort series.

The Research Questions in this Chapter

The two main research questions addressed in this chapter are: 1). Can actuarial tools be created to predict rare offending events such as arson offending? 2). Are individuals who commit arson qualitatively different from individuals with non-arson criminal histories?

INTRODUCTION

Given that we have already discussed the literature review in previous chapters of this thesis we will now briefly outline the primary goals, objectives and stages of this present study. As stated, the primary purpose of the present study was to test the generalizability and utility of the Edwards and Grace (2014) second-generation actuarial arson model across different (non-overlapping) samples of convicted offenders in NZ. To achieve this, the authors replicated their previously published work (Edwards & Grace, 2014) but with a new series of data with no-overlapping between the two arson cohorts (series one 1984 to 1995 and series two 1998 to 2008). This supports the rationale for replicating and extending on the previously developed tool (in chapter 2) and the need to develop additional actuarial risk prediction models for arson and compare them with violent and non-violent recidivism models.

The current study is designed to investigate how the arson models (original and current) compares against an exclusive and specific sample of violent offenders (no prior or post arsons) and an exclusive and specific sample of non-violent offenders (no prior or post arsons). The authors do note that the design of the original arson, violent and non-violent predictive models were developed exclusively from the same arson cohort. In this replicated study we obtained three exclusive unique types of offenders that are best suited for

comparative purposes and would provide a more accurate evaluation and representation of various types of offenders in the NZ context.

One of the goals of the present study was to develop and compare predictive models for arson, violent and non-violent recidivism and build a comparative second-generation actuarial model for arson recidivism. In doing this, the authors are able to assess the generalisability and utility of the original Edwards and Grace (2014) tool. We identified a cohort of 1464 participants who represented all those convicted with at least one arson offence in NZ between 1998 and 2008. We also identified a random sample of 1464 participants who were convicted with at least one violent offence (no prior or post arsons) and a random sample of 1464 participants convicted with at least one non-violent offence (no prior or post arsons) in NZ during the same period.

The researcher's decision not to include post arson offences (during the follow-up period) for the violent and non-violent sample of offenders is due to the research design. That is, the study was designed to investigate three unique and specific groups of offenders, which neatly captures a sample of pure violent and non-violent offenders that cannot be consumed or identified as arson offenders at any point throughout their criminal careers. In total, three separate groups were investigated which comprised of 4392 NZ convicted offenders in NZ and who were all processed by the NZ criminal justice system. The arson, violent and non-violent groups were followed up for a period of 5-years and all subsequent offences were recorded, analysed and compared.

METHOD

NZ Ministry of Justice

A request was made to the NZ Ministry of Justice for access to offender records from the NZ Department of Corrections. The start date was 1998 due to the data being readily obtainable from the CAARS automated request system. The data requested included all demographic and offence history information for a cohort of convicted arson offenders and a randomly selected sample of violent and non-violent offenders. To identify the required sample size and year selected for each group, the first step was to define the arson sample. That is, the number of convicted arson offenders from 1st January 1998 to 31st December 2008. Information was provided by the NZ Ministry of Justice which identified the total number of convicted arson offenders stratified during a 10-year period. In total, 1464 offenders were identified as being convicted of an arson offence during the defined period. If the participant had multiple arson convictions, that participant was counted in the year of their first arson conviction only and not consumed with of the additional arson conviction dates.

Defining the Groups

To define the arson cohort the following NZ offence codes were used; '5110', '5111', '5112', '5113', '5116' and '5119' (see Appendix A). The arson cohort was accepted by the authors due to its comparability with the Edwards and Grace (2014) study of 1250 convicted arson offenders. We used the same sample size (n = 1464) over the same year range 1998 to 2008 to obtain two randomly selected samples of offenders who were convicted of; firstly, violent offences using NZ Police offence codes in the 1000's, but no arson offences (prior and post),

secondly, non-violent offences not used in the previous two samples (no arsons prior and post and no violent related-offences at the criterion date). In all, three unique groups were identified, 1) arson offenders; 2) violent offenders and 3) non-violent offenders.

Participants

Overall, the NZ Ministry of Justice identified a cohort of 1464 participants who were charged and convicted with at least one arson offence in NZ between 1998 and 2008. In addition, 1464 participants were identified who were charged and convicted with at least one violent offence in NZ during the same period. Last, 1464 participants were identified who were charged and convicted with at least one non-violent offence in NZ during the same period. In total, the study investigated 4392 NZ convicted offenders who were in NZ at the time of their offending. For the arson, violent and non-violent groups, the first such offence fitting the criterion for inclusion was defined as the criterion offence. For the criterion offence, 1464 participants in each of the three groups were convicted for their respective criterion offences (arson, violent, and non-violent). Those participants convicted from youth courts were eligible, but all were required to be age 14-years or older at the time of their first arson, violent or non-violent offence (index offence). Based on the information presented, the three identified groups were deemed to be criminally responsible at the time of their respective criterion offences (arson, violent and non-violent).

For all arsons, including subsequent arsons committed during the 5-year follow-up period, the data did not identify any cases that were found not guilty by reason of insanity, acquitted insane, received any forensic psychiatric evaluations, presented diminished responsibility or were diagnosed as Pyromania. The arson cohort comprised of all convicted arson offenders in

NZ between 1998 and 2008 and who were processed through the NZ criminal justice system and not from a forensic or clinical setting. This resulted in an arson cohort of 1464 participants used for the purpose of this study.

Data Collection Procedures

Criminal offence history, this included offence dates, NZ Police codes, sentence type, District, court hearing dates, hearing outcomes, sentence length (days), release dates and all demographic information (age, gender and ethnicity) were obtained. Prior offence types were coded and grouped into one of the following offence types; arson (for the arson cohort), violent, vandalism, theft, drug, sexual, driving and non-violent offence category. The research dataset was supplied on an MS Excel spreadsheet and included a unique offender ID, cohort type and year selected. Of note, several count-based variables were positively skewed and therefore were recoded for further analysis.

One of the main objectives of this study was to investigate arson, violent and non-violent recidivism over a 5-year follow-up period. For each participant, the criterion date was the date immediately following the year selected for each participant. The criterion offence was the first primary index conviction recorded for their respective arson, violent or non-violent offence. By contrast, the criterion date for the Edwards and Grace (2014) study was the date of the participant's first arson court hearing after their arson criterion offence. The current dataset did not include all participants first arson court appearances (missing information), therefore the year selected for each participant best represented the criterion date and were used for this purpose of this study.

Defining Recidivism

Recidivism was defined as a conviction or detainment for any type of offence that occurred during the 5-year follow-up period. For all those participants who had been given a term of imprisonment for their criterion offence, the end of the follow-up period was defined as 5-years after the criterion date plus their full prison sentence added on (official prison release dates were obtained). Arson recidivism was defined as a subsequent arson offence defined by NZ Police Codes ('5110', '5111', '5112', '5113', '5116' and '5119') that occurred after the criterion date and prior to the end of their 5-year follow-up. Violent recidivism was defined as a subsequent violent conviction against another person and excluded all arson-related offence codes as discussed. Non-violent recidivism was recorded as any other criminal conviction not subsumed by the arson and violent offence codes. For the three recidivism types (arson, violent and non-violent) all were recorded when the participant committed a subsequent arson, violent and non-violent offence during their respective 5-year follow-up. This design criteria and its definition are subsequently used for the following analyses, the survival curves and survival times (discussed next).

Missing Data

Missing data from the NZ Ministry of Justice must be acknowledged and discussed so that we may understand the extent and nature of these limitations from the dataset provided. The missing data were the criterion hearing dates, that is, the dates of the first court hearing after their criterion offence (arson, violent and non-violent index offences). These dates were fundamentally important in the Edwards and Grace (2014) study as it played a key role in consistently commencing the recidivism start time for their 10-year follow-up period. With

this second arson cohort sample the authors had to make necessary adjustments to the criterion date and define what the new and consistent criterion date would be. The criterion date guidelines and the commencement of follow-up were different to the Edwards and Grace (2014) study. Therefore, we followed participants through different segments or points in time during their criminal careers. That is, we took the commencement of their follow-up period at some point in time during the defined year selected by the NZ Ministry of Justice. With this varied the methodology and this approach would likely capture the criminal careers of the participants at varying segments throughout their lives. Although some missing data is common place and may have impacted the commencement of the participants 5-year follow-up period, the missing data in isolation did not necessarily impact the overall findings of this study given the large sample size obtained (n = 1464).

Ethics

Ethical approval for this research was obtained by the University of Canterbury Human Ethics Committee, reference HEC 2013/143. (see Appendix C).

Approval to undertake research using NZ Department of Corrections data was granted by the Ministry of Justice, Research, Evaluation and Modelling Unit, Wellington.

The statements and opinions expressed in this research are those of the authors and do not necessarily represent the views of the NZ Ministry of Justice.

Data Analysis

Descriptive statistics were conducted on the whole sample of 4329 NZ convicted offenders. This comprised of an arson cohort (n = 1464), violent sample (n = 1464) and non-violent sample (n = 1464). All prior offence variables for the descriptive statistics relied on the raw variable data. Pearson's Chi-square statistics were conducted on the categorical variables, such as gender and ethnicity. One-Way ANOVA's were performed as a qualitative measure to compare mean age-related demographics, number of prior offence history variables and survival times for the three groups. Post Hoc Tests (using the Tukey HSD) was used to identify any mean significant pairwise differences between the groups and age-related variables and prior offence history variables. The raw number of prior offence variables were used as the dependant variable, F-ratio, p-value and subscripts were included for each mean to indicate any significant differences according to pairwise comparisons.

Survival Curves and Survival Times (Time to Fail)

The Kaplan-Meier was the primary method employed to develop survival curves for the arson cohort, violent sample and non-violent sample for each recidivism type (arson, violent and non-violent) during the 5-year follow-up period. The survival curves were based on the percentage of non-recidivists against the days of opportunity to fail (1825 days). That is, we provide a visual representation of how many individuals do not repeat an offence of its kind during a 5-year follow-up period, that is a 5-year period of "at-risk" to reoffend. The survival curves in essence, represents an individual's first repeat offence of its kind for arson, violent or non-violent crimes for all three groups (arson cohort, violent sample and non-violent sample) during a 5-year follow-up period. For the purposes of the survival curve test, full

criminal histories were only examined during the individuals 5-year follow-up period (not prior). Survival curves are produced for each recidivism type (arson, violent and non-violent) and the percentage of non-recidivists range from 0 to 1.0 (see figure 6). For example, if the survival curve were at a flat line at 0 (y-axis) and across the 5-year duration (x-axis) this would indicate that the whole sample were recidivists (all individuals had reoffended at some point in time during a 5-year period). Alternatively, if the survival curve were at 1.0 (y-axis) across a 5-year duration (x-axis) this would indicate that the whole sample were non-recidivists (no individuals had committed any type of offence of its kind in a 5-year period).

Of note, there are three survival curves for violent and non-violent recidivism (for each group) but only one survival curve for arson recidivism (for the arson cohort). Both the violent and non-violent samples have no arson offences (as per the study criteria), therefore only the one generated curve for arson.

Further, independent-samples *t*-tests were conducted between the three groups to identify any significant differences between violent and non-violent recidivism during the 5-year follow-up. Next, a Log-rank (Mantel-Cox) test was also conducted to test the overall comparison and equality of the survival distributions between the arson, violent and non-violent samples. Last, we conducted a one-way ANOVA to compare and assess the average time to reoffend (survival times) across the arson, violent and non-violent samples.

Pearson Correlations

Pearson correlations using bivariate analyses were used to examine the relationship between potential static risk factors and arson, violent and non-violent recidivism. This relied on the

arson cohort, violent and non-violent samples 5-year reconviction data against demographic and prior offence history variables. This test examined which static risk predictors for each group are significantly correlated with the respective recidivism types. All prior offences relied on recoded variables and significant correlations are noted at the $p < 0.05$ and $p < 0.01$ levels. The bivariate correlations provide particularly valuable information on whether certain risk factors are different across the groups in terms of their predictive relationships with recidivism. This set of analyses are an important preliminary step in developing actuarial models for predicting arson, violent and non-violent recidivism.

Arson, Violent and Non-violent Predictive Models

One of the major goals of the present study was to develop and compare predictive models for arson, violent and non-violent recidivism. We employed binary logistic regression to develop the best fitting models for each recidivism type for each offender group. For each model, the remaining variables in the equation at the final step were used to develop the models. We used the Hosmer-Lemeshow (goodness-of-fit) method and the forward conditional (binary method) for the predictor variables. In total, seven actuarial models were developed from this type of analysis: three recidivism models from the arson cohort, two recidivism models from the violent sample and two recidivism models from the non-violent sample. The predictor variables for each model were entered at $p < .05$ criterion for inclusion at each step. Of note, this present study did not employ a cross validation strategy which was previously used in the Edwards and Grace (2014) study. As discussed, the cohort from the authors previous study was randomly divided into developmental and validation subsamples and the predictive arson model were estimated based on the developmental subsample using forward stepwise survival analysis (cox regression). However, the present study employed

binary logistic regression to develop the best fitting models for each recidivism type. Given that the first study (Edwards & Grace, 2014) employed a split half sample approach to test the validity of its model, the authors did not deem this necessary to split half the current arson cohort. The purpose of this second study was to replicate the Edwards and Grace (2014) study and test the generalisability and utility of the model not to revalidate its original findings.

The accuracy of all developed models from this study were measured in terms of the area under the Receiver Operating Characteristics (ROC) curve (Rice & Harris, 1995). We obtained all pooled AUC scores for each group and compared them against the AUC scores from both empirical studies. Following this, we compared the ROC scores between the three groups using the pROC package and the DeLong test. This compared the AUC values, z test scores and p values between the groups and each violent and non-violent recidivism types (DeLong, DeLong, & Clarke-Pearson, 1988). Further, using ROC analyses, researchers are able to develop accurate risk prediction tools which provide true positive and true negative conditions, as opposed to false positive and false negatives (Type I and II errors).

Arson Actuarial Tools

As a result of developing the actuarial risk prediction model for arson recidivism, we were able to replicate the Edwards and Grace (2014) actuarial model. This analysis relied on the arson cohort model scores to generate values for the arson model categories. These scores were based on the sum of the same three predictor variables which were used in the original Edwards and Grace (2014) model; first arson < 18-years, multiple arsons at the criterion date and number of prior vandalism offences. These same three predictor variables were further

coded similarly; 0-3, 0-5 and 0-2. The defined risk distribution scales for the classification scale varied from 0 to 10, with lower risk scores (0-1) indicating low-risk and higher risk scores (7-10) indicating higher risk for arson recidivism. To develop the actuarial risk scale for this study, we constructed the same four risk bands ranging from 0 to 3 and using the sum of the arson model scores from the arson cohort: low (0 to 1), medium-low (2 to 3), medium-high (4 to 6) and high (7 to 10). The four risk bands were ranked as low = 0, medium-low = 1, medium-high = 2 and high = 3. The predictive accuracy of the arson risk classification scale was assessed by computing the area under the ROC curves (AUC). Last, we compared this model against the original Edwards and Grace (2014) model to identify any differences or similarities.

The next set of analyses compared pairwise effect sizes between the three groups. The purpose of this test was to provide a summary of the pairwise comparisons between the arson cohort against the violent and non-violent samples. Pairwise comparisons were measured by its effect size (Cohen's *d*) and any significant pairwise comparisons (Cohen's *d*) are shown in bold.

Linear Discriminant Analysis (LDA)

A series of statistical methods which was not used in the first arson cohort series but are utilised in this second arson cohort series is LDA. One of the key objectives of using LDA is to determine whether we can accurately classify a group of arson offenders against a group of violent and non-violent offenders. The aim of this analysis was to determine if we can classify and evaluate prior offence history variables as key predictors for group membership. The offences included in this analysis were; number of prior violent, drugs, driving, theft, vandalism, sexual and non-violent offences. Of note, the prior drug variable did not make

final inclusion in the LDA analysis. Log scaled offence history variables were used as independent predictor variables and the dependent variable were the three groups. This analysis will use the stepwise method and relied on the Leave-one-out classification approach.

Following this, a classification procedure will be conducted to assign cases into the predicted group memberships to determine which group/s if any are correctly classified and cross-validated. The aim of this procedure is to determine the classification accuracy by more than chance levels alone (33.3%). That is, can we correctly classify the arson group against a group of violent and non-violent offenders.

All statistical analyses were conducted using IBM Statistical Package for the Social Sciences (SPSS), Version 25.

All significance tests and analyses used the .05 level and obtained *p* values are reported to $p < .001$.

RESULTS

Demographics

Descriptive statistics were conducted on a total sample size of 4392 NZ convicted offenders. This comprised of a cohort of 1464 arson offenders, a random sample of 1464 violent offenders (no prior or post arson offences) and a random sample of 1464 non-violent offenders (no prior or post arson offences). For the arson cohort 86% (n = 1265) were male

and 14% (*n* = 199) were female; for the violent sample 87% (*n* = 1267) were male and 13% (*n* = 197) were female and for the non-violent sample 81% (*n* = 1191) were male and 19% (*n* = 273) were female. Table 13 presents the gender breakdown for the arson cohort, violent and non-violent samples. A Chi-square test indicated that the proportion of female offenders was not significantly different across the three groups. A Chi-square result of ($df = 2$) = 19.85, $p < .001$ was obtained, this confirmed that the proportion of female offenders was greater in the non-violent group compared to the arson and violent groups.

Table 13

Gender Breakdown for the Arson Cohort, Violent and Non-violent Samples

Gender	Arson		Violent		Non-violent	
	n	***%***	***n***	***%***	***n***	***%***
Male	1265	(86)	1267	(87)	1191	(81)
Female	199	(14)	197	(13)	273	(19)

Note. Total *n* = 1464 (arson cohort), *n* = 1464 (violent sample), *n* = 1464 (Non-violent sample).

For the arson cohort, the largest ethnic group were NZ European/Caucasian 58% (*n* = 849), the next largest group being NZ Māori 32% (*n* = 470), followed by small number of Pacific Islands/Polynesian 6% (*n* = 82) and other ethnic groups 4% (*n* = 63). For the violent sample, 51% (*n* = 749) were NZ Māori, 31% (*n* = 452) were NZ European/Caucasian, 12% (*n* = 182) were Pacific islands/Polynesian and 6% (*n* = 81) were from other ethnic groups. For the non-violent sample, 45% (*n* = 656) were NZ Māori, 41% (*n* = 603) were NZ European/Caucasian, 8% (*n* = 119) were Pacific Islands/Polynesian and 6% (*n* = 86) were from other ethnic groups. The ethnicity breakdown for the arson cohort, violent and non-violent samples are presented in table 14.

A Chi-square test was conducted to report the ethnic distributions (NZ European, NZ Māori, Pacific Islands/Polynesian and other) across the three groups. A Chi-square result of X^2 = 234.980, df = 6, p < .001 was obtained, this indicated that the ethnicity proportions were significantly different across the groups (arson, violent and non-violent samples). Further, the results suggest that there were significantly more NZ European and fewer NZ Māori in the arson cohort. In contrast, there were significantly more NZ Māori and fewer European in the violent sample and relatively more NZ Māori than European in the non-violent sample.

Table 14

Ethnicity Breakdown for the Arson Cohort, Violent and Non-violent Samples

Ethnicity	**Arson**	**Violent**	**Non-violent**
	n ***%***	***n*** ***%***	***n*** ***%***
NZ Māori	470 (32)	749 (51)	656 (45)
European/Caucasian	849 (58)	452 (31)	603 (41)
Pacific Islands/Polynesian	82 (6)	182 (12)	119 (8)
Other	63 (4)	81 (6)	86 (6)

Note. Other (Includes other ethnic groups). Total n = 1464 (arson cohort), n = 1464 (violent sample), n = 1464 (Non-violent sample).

For age-related demographics, the average age at the criterion date for the arson cohort was 26.81-years (SD = 10.04) and ranged from 14.25-years to 73.72-years. The average age at the first arson offence was 26.47-years (SD = 9.90) with the same age range of 14.25-years to 73.72-years. For the violent sample, the average age at the criterion date was 28.03-years (SD = 9.95) and ranged from 15.09-years to 70.96-years. The average age at the first violent offence was 24.69-years (SD = 8.97) with the same age range of 15.09-years to 70.96-years. For the non-violent sample, the average age at the criterion date was 26.71-years (SD = 10.31) and ranged from 15.10-years to 76.30-years. The average age at the first non-violent

offence was 22.46-years (*SD* = 8.06) and ranged from 14.34-years to 65.04-years. These results suggest that the average age at criterion for the arson cohort and the non-violent sample were relatively the same compared to the violent sample who were older at the age of their criterion date. Arson offenders were on average older at the age of their first arson offence compared to violent and non-violent offenders. The age-related demographics for the arson cohort, violent and non-violent samples are presented in Table 15.

Table 15

Age-related Demographics for the Arson Cohort, Violent and Non-violent Samples

Group	Age Variables	*m* (*SD*)	Min	Max
Arson	Age at Criterion	26.81 (10.04)	14.25	73.72
	Age at First Arson Offence	26.47 (9.90)	14.25	73.72
Violent	Age at Criterion	28.03 (9.95)	15.09	70.96
	Age at First Violent Offence	24.69 (8.97)	15.09	70.96
Non-violent	Age at Criterion	26.71 (10.31)	15.10	76.30
	Age at First Non-violent Offence	22.46 (8.06)	14.34	65.04

Note. Min (minimum age in years); Max (maximum age in years).

The following summarises the main findings and key comparisons between the arson, violent and non-violent groups. A One-Way Analysis of Variance (ANOVA) test was performed to compare mean age demographic variables (age at criterion and age at first offence) and offence history (number of prior convictions) across the arson, violent and non-violent samples. The mean comparisons between the three groups across the age and offence history variables are presented in table 16. First, the results indicate that for the age at criterion variable, the overall *F* ratio produced a significant result [$F(2, 4274) = 7.61$, $p = 0.001$]. That is, the arson cohort and the non-violent sample had a similar mean age and both were significantly younger than the violent sample. Overall, arson offenders and non-violent

offenders were younger at their criterion date compared to violent offenders who were on average slightly older. Second, for the age at first offence, the overall *F* ratio produced a significant result [$F(2, 3972) = 44.86$, $p < 0.001$]. These findings indicate that the arson cohort and the violent sample have a similar mean age at the time of their first offence and were both slightly younger than non-violent offenders.

Next, we compared and summarised arson offender's average prior criminal convictions (violent, vandalism, theft, drug, sexual, driving and non-violent) compared to the violent and non-violent offenders. The mean comparisons between the arson cohort, violent and non-violent samples across various offence history variables are presented in table 17. The *F* ratio for the average number of prior violent offences was [$F(2, 4389) = 20.27$, $p = 0.001$]. The arson cohort and the violent sample on average had relatively similar number of prior violent convictions compared to the non-violent sample which had significantly less prior violent convictions. The *F* ratio for the average number of prior drug offences was [$F(2, 4389) = 12.49$, $p = 0.001$]. This result indicates that the arson cohort and the violent sample on average had somewhat similar number of prior drug convictions compared to the non-violent sample who had significantly smaller number of prior drug convictions. The *F* ratio for the average number of prior sexual offences was [$F(2, 4389) = 3.93$, $p = 0.02$]. These results suggest that the arson cohort and the violent sample on average had relatively similar number of prior sexual convictions compared to the non-violent sample who had significantly more prior sex-related convictions. The *F* ratio for the average number of prior non-violent offences was [$F(2, 4389) = 23.23$, $p = 0.001$]. This suggest that the arson cohort and the violent sample on average had relatively similar number of prior non-violent convictions compared to the non-violent sample which had significantly less offences.

For the remaining number of prior convictions for vandalism [$F(2, 4389) = 31.45$, $p = 0.001$] this showed that the arson cohort on average had significantly more prior vandalism convictions compared to the violent sample and the non-violent sample. The theft variable [$F(2, 4389) = 18.18$, $p = 0.001$] indicated that the arson cohort on average had significantly greater number of prior theft offences compared to the violent sample and the non-violent sample. Last, the driving variable [$F(2, 4389) = 18.25$, $p = 0.001$] indicated that the violent sample on average had significantly greater number of prior driving convictions compared to the arson cohort and the non-violent sample.

The main conclusions drawn from these results is that arson offenders and non-violent offenders are similar in age at the time of their criterion date. Although, arson offenders and violent offenders were similar in age at the time of their first offence (any type). For offence history (number of prior convictions) the results suggest that arson offenders have relatively similar number of prior violent, drug, sexual and non-violent offences with violent offenders with no similarities with non-violent offenders. Last, it was identified that arson offenders had more prior vandalism and theft-related convictions compared to violent and non-violent offenders.

Cohen's *d*

The next set of analyses compared pairwise comparison effect sizes between the arson cohort, violent and non-violent samples against age-related and prior offence history variables. The purpose of this analysis was to identify any differences between the arson cohort and the violent and non-violent samples and its predictor variables. The pairwise comparisons were measured in terms of its effect size (Cohen's *d*) which emphasise the size of the difference

between any two groups, these are presented in table 16. The significant pairwise comparisons (Cohen's *d*) are shown in bold.

For the two age-related variables, the findings from this analysis indicate that for the age at criterion variable, the combination between the arson cohort and violent sample and the violent and non-violent sample provided small effect sizes but more so for the arson cohort and non-violent sample. For the age at first offence variable, the combination between the arson cohort and the non-violent sample and the violent sample and the non-violent sample provided small effect sizes but more so for the arson cohort and violent sample. These comparisons all provide a small effect size. Over these findings suggest that there was not enough statistical power to detect a small effect size and there are no differences between these groups in various combinations for the age-related factors.

For prior offence history variables, the findings indicate that prior violent, prior drug and prior non-violent variables produced small effect sizes between the arson cohort and non-violent sample and for the violent and non-violent sample but more so for the arson cohort and violent sample. For the remaining variables; prior vandalism, prior theft, prior sexual and prior driving variables produced small effect sizes between the arson cohort and the violent sample, arson cohort and the non-violent sample and the violent and non-violent samples.

Overall, the Cohen's *d* effect size between the various group combinations for the arson cohort and violent, arson cohort and non-violent and the violent and the non-violent samples across age-related and offence history variables did not exceed the Cohen's (1988) convention for small effect size ($d = 0.20$).

Table 16

The Mean Comparisons and Cohen's d Effect Size for the Arson, Violent and Non-violent Samples Across Age and Offence History Variables

Static Variables	Cohen's *d*	Arson *m*	Arson *SD*	Violent *m*	Violent *SD*	Non-violent *m*	Non-violent *SD*	*F*
Age at Criterion		26.81_b	(10.04)	28.03_a	(9.95)	26.71_b	(10.31)	7.61***
	Arson	-		**0.12**		0.01		
	Violent	**0.12**		-		**0.13**		
	Non-violent	0.01		**0.13**		-		
Age at First Offence		21.74_a	(7.92)	21.87_a	(7.92)	22.44_b	(8.19)	44.86***
	Arson	-		0.02		**0.09**		
	Violent	0.02		-		0.07		
	Non-violent	**0.09**		**0.07**		-		
Violent		1.13_a	(2.58)	1.12_a	(2.33)	0.67_b	(1.73)	20.27***
	Arson	-		0		**0.21**		
	Violent	0		-		**0.22**		
	Non-violent	**0.21**		**0.22**		-		
Vandalism		0.48_a	(1.65)	0.28_b	(0.82)	0.16_c	(0.56)	31.45***
	Arson	-		**0.15**		**0.26**		
	Violent	**0.15**		-		**0.17**		
	Non-violent	**0.26**		**0.17**		-		
Theft		4.56_a	(10.74)	3.45_b	(8.38)	2.59_c	(7.12)	18.18***
	Arson	-		**0.12**		**0.22**		
	Violent	**0.12**		-		**0.11**		
	Non-violent	**0.22**		**0.11**		-		
Drug		0.77_a	(1.96)	0.90_a	(2.06)	0.56_b	(1.52)	12.49***
	Arson	-		0.06		**0.12**		
	Violent	0.06		-		**0.19**		
	Non-violent	**0.12**		**0.19**		-		
Sexual		0.06_b	(0.39)	0.08_{ab}	(0.46)	0.14_a	(1.24)	3.93*
	Arson	-		**0.05**		**0.09**		
	Violent	**0.05**		-		**0.06**		
	Non-violent	**0.09**		**0.06**		-		
Driving		1.52_b	(3.46)	1.87_a	(3.91)	1.12_c	(2.56)	18.25***
	Arson	-		**0.09**		**0.13**		
	Violent	**0.09**		-		**0.23**		
	Non-violent	**0.13**		**0.23**		-		
Non-violent		9.07_a	(16.48)	8.50_a	(14.68)	5.71_b	(11.16)	23.23***
	Arson	-		0.04		**0.24**		
	Violent	0.04		-		**0.21**		
	Non-violent	**0.24**		**0.21**		-		

Note. The significant pairwise comparisons (Cohen's *d*) for the three groups across each variable are shown in bold. A One-way analyses of variance (ANOVA) were conducted for the arson, violent and non-violent groups. The values with different letter subscripts (a, b, c) were significantly different according to post-hoc tests (Tukey HSD). *$p < .05$; ***$p < .001$.

The results reported here indicated a small effect size, although this is not a limitation, there is simply insufficient statistical power to detect group comparisons above a small effect size. Of note, significant pairwise comparisons (Cohen's *d*) are shown in bold, none of the results provided in this section produced medium or large effect sizes.

Survival Curves for Arson, Violent and Non-violent Groups (Time to Fail)

Survival curves for each group were developed using the Kaplan-Meier method, the same methodology employed in the Edwards and Grace (2014) study. The purpose of the survival curves was to provide a visual aid to reflect the scope of the re-offending rates for arson, violent and non-violent recidivism over a 5-year follow-up period (in days). In essence, the arson, violent and non-violent survival curves represent those individuals who committed a repeat offence of its kind following their respective criterion dates and followed for up to 5-years. Of note, the survival curves for the groups are primarily based on recidivism data (information post criterion date) of which was obtained from the follow-up period, full and complete criminal histories (prior to the criterion dates) were not examined nor necessary for the purpose of this test.

Figure 6 presents the survival curve for arson recidivism, with the percentage of non-recidivists against days of opportunity to fail (time "at-risk" to reoffend). A visual inspection of the survival curve indicates that the arson recidivism curve is close to 0.95 (percentage of non-recidivists) this would indicate that most of the arson sample were non-arson recidivists. This is matched by the arson recidivism rate of 5.87% (n = 86/1464) indicating that a small group of arsonists committed a subsequent arson offence during their follow-up period. Of note, there is only one survival curve for arson reoffending, given that both the violent and

non-violent samples had no prior or post arson offences (see method section) and are therefore not captured in this figure.

Figure 6

Survival Curve for Arson Recidivism from the Arson Sample

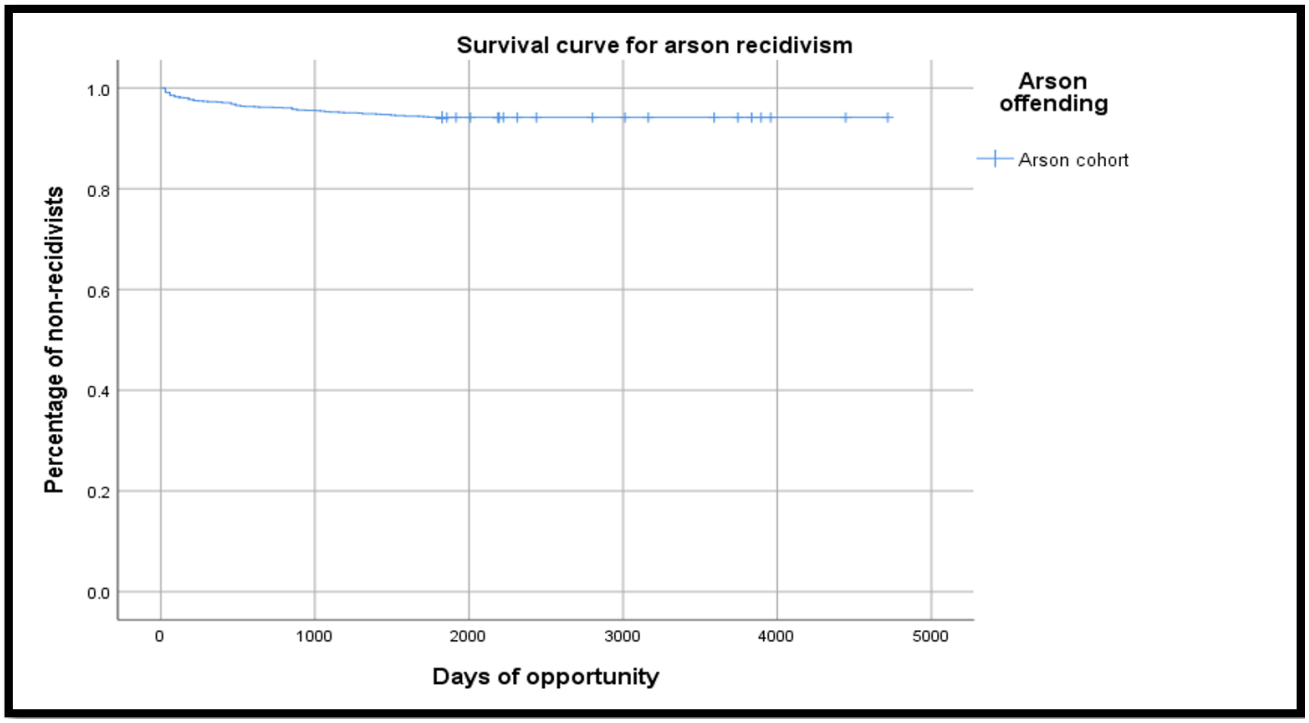


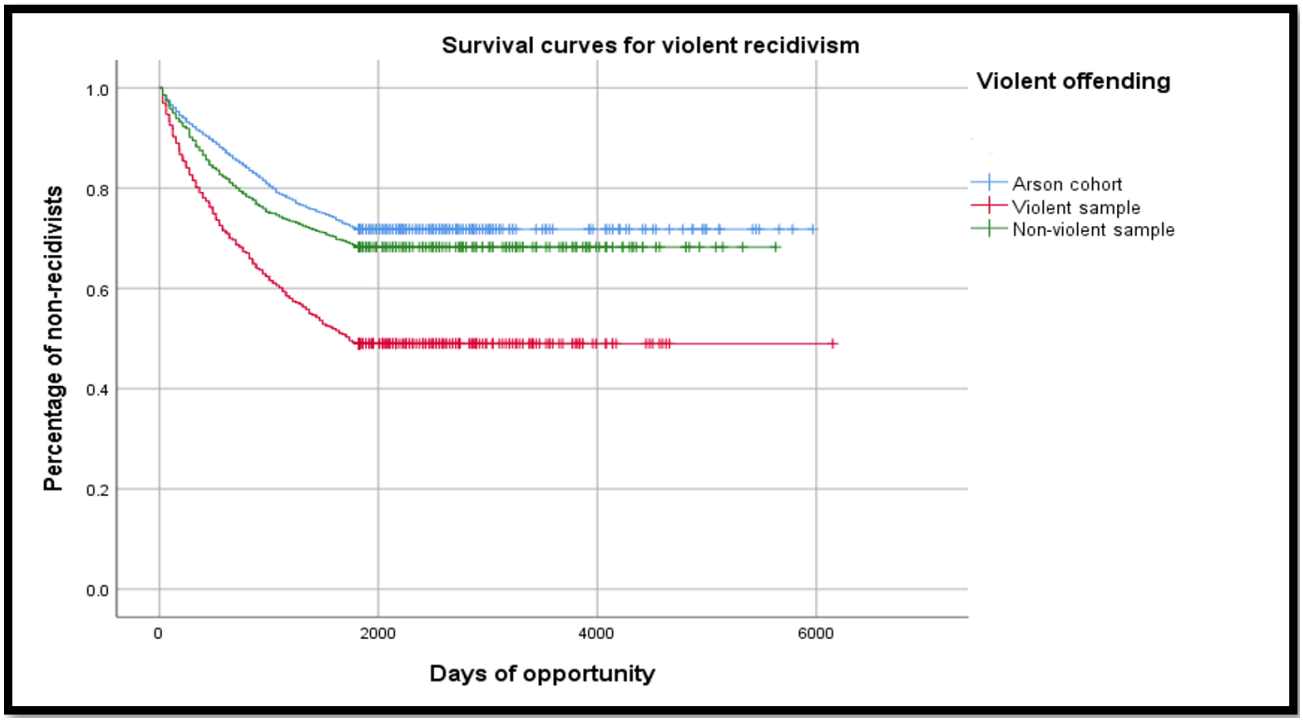
Figure 7 presents the survival curves for violent recidivism for all three groups (arson, violent and non-violent) over the 5-year follow-up period. This figure presents the survival curve for violent recidivism, with the percentage of non-recidivists for violent offences against days of opportunity to fail. The curve for the arson cohort is close to 0.7, this indicates that about a third of the arson sample had committed a subsequent violent offence during their follow-up period. For the violent sample, the curve was close to 0.5, this indicates that about half of the violent sample recommitted a violent offence during their follow-up period. Last, for the non-violent sample, the curve was close to 0.7, this indicates that about a third of the non-violent sample recommitted a violent offence during their follow-up period. These figures reflect the

percentage of non-recidivists for each group and the remaining percentages reflecting the violent recidivism rates. The violent recidivism rates for the arson cohort was 28.21% (n = 413/1464), the violent sample was 51.02% (n = 747/1464) and the non-violent sample was 31.76% (n = 465/1464).

The test revealed that the violent sample indicated higher recidivism rates for violent reoffending compared to the arson cohort and non-violent sample. The arson cohort and non-violent sample produced similar violent re-offending rates and were much less than the recidivism rate for the violent sample. Further, the arson cohort were least likely to commit a new violent offence during follow-up compared to the violent and non-violent samples. A Log-rank (Mantel-Cox) test statistic was also conducted from the Kaplan-Meier analysis. This test provided the overall comparison and equality of the survival distributions between the arson cohort, violent and non-violent sample. The results provided a Chi-square result of 206.056, df = 2, p > .001. These results confirm a significant difference between the arson cohort, violent and non-violent samples when comparing respective violent recidivism rates.

Figure 7

Survival Curves for Violent Recidivism from the Arson, Violent and Non-violent Samples



Last, figure 8 presents the survival curves for non-violent recidivism in the arson cohort, violent and non-violent samples over the 5-year follow-up period. The survival curve represents a visual representation of the survival curve for non-violent recidivism. The curve for the arson cohort is close to 0.4, this indicates that just under two-thirds of the arson sample had committed a subsequent non-violent offence during their follow-up period. For the violent sample, the curve was close to 0.35, this indicates that about two-thirds of the violent sample recommitted a non-violent offence during their follow-up period.

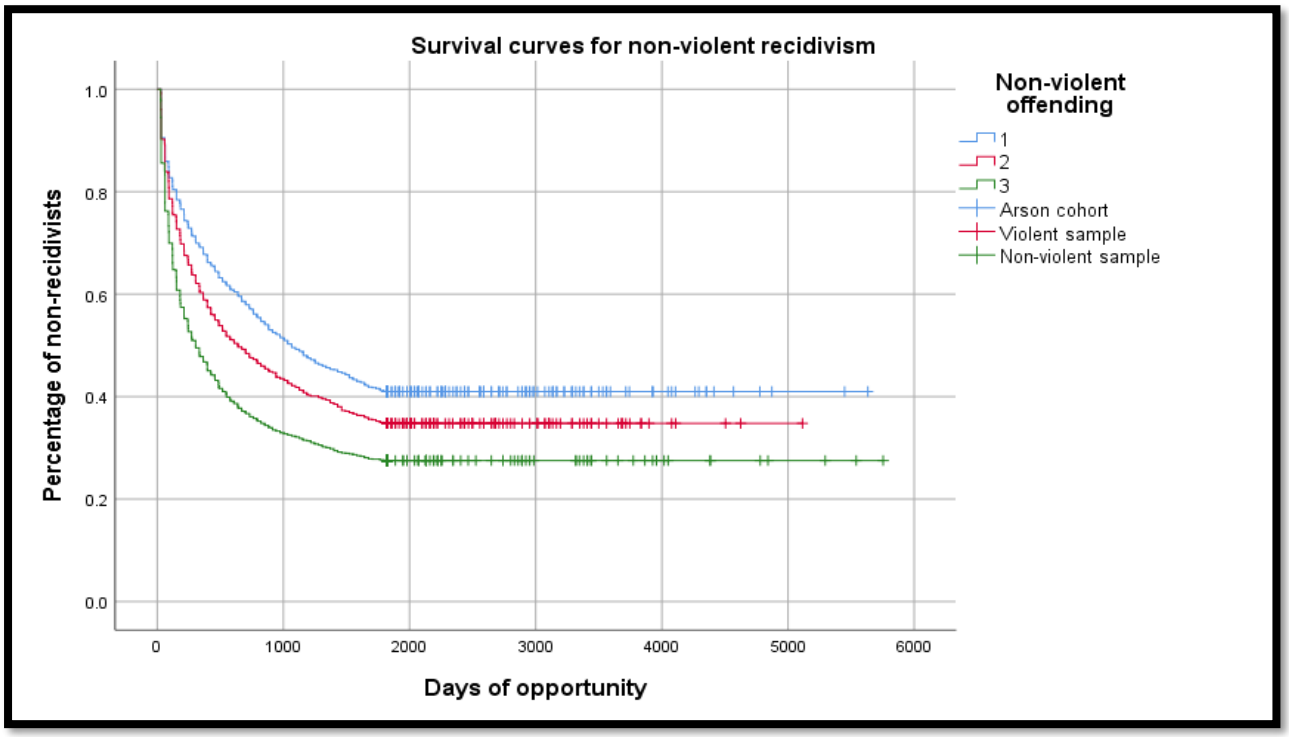
Finally, for the non-violent sample, the curve was close to 0.28, this indicates that about three-quarters of the non-violent sample recommitted a non-violent offence during the follow-up period. These figures reflect the percentage of non-recidivists for each group and the remaining percentages reflecting the non-violent recidivism rates. The non-violent

recidivism rates for the arson cohort was 59.02% (*n* = 864/1464), for the violent sample was 65.23% (*n* = 955/1464) and for the non-violent sample was 72.47% (*n* = 1061/1464).

The test revealed that the non-violent sample showed higher recidivism rates and were more likely to commit subsequent non-violent offences compared to the arson cohort and violent sample. Further, the arson cohort were least likely to commit a new non-violent offence during the follow-up compared to the violent and non-violent samples. A Log-rank (Mantel-Cox) test statistic was conducted and the following results were provided: Chi-square 106.470, *df* = 2, *p* < .001. This result confirms a significant difference between the arson cohort, violent and non-violent samples when comparing respective non-violent recidivism rates.

Figure 8

Survival Curves for Non-violent Recidivism from the Arson, Violent and Non-violent Samples



Survival Times (Average Time to Fail)

The next step in the survival curve analysis is to compare the average time to fail, that is, on average, how long does it take an individual to commit a repeat offence of its kind. The purpose of this analysis is to determine whether those individuals from the arson cohort re-offended more, or less quickly over time for violent and non-violent offences compared to the sample of violent and non-violent offenders. And if so, what was the average time to failure or time to reoffend in days. Table 17 presents the survival time/average time to fail (in days) for those individuals in the arson cohort, violent and non-violent samples.

The following results indicate the mean time to failure or reoffend during the 5-year follow-up period with minimum and maximum days to reoffend for each group (arson, violent, and non-violent).

For the 86 offenders in the arson cohort that committed a subsequent arson offence during the follow-up period, the mean time to failure (commit a subsequent arson) was 1765.74 days (*SD* = 367.00) with a minimum of 28 days and a maximum of 4717 days to reoffend. For those 413 arson offenders that committed a subsequent violent offence, the mean time to failure was 1652.22 days (*SD* = 794.51) with a minimum of 28 days and a maximum 5967 days to reoffend. For the 864 arson offenders that committed a subsequent non-violent offence, the mean time to failure was 1120.78 days (*SD* = 911.69) with a minimum of 28 days and a maximum of 5632 days to reoffend. Overall, these findings suggest that the arson cohort committed a subsequent non-violent offence significantly quicker compared to violent offences and arson offences. Thus, arson offences took the longest time to re-offend compared to violent and non-violent reoffending within the arson cohort.

For the 747 offenders in the violent sample that committed a subsequent violent offence during the follow-up period, the mean time to failure (commit a violent offence) was 1320.41 days (*SD* = 869.55) with a minimum of 28 days and a maximum of 6149. The 955 offenders that committed a subsequent non-violent offence, the mean time to failure was 966.44 days (*SD* = 884.15) with a minimum of 28 days and maximum of 5114 days to reoffend. Overall, these findings suggest that the violent sample reoffended significantly more quickly for non-violent offences compared to violent offences.

For those 465 offenders in the non-violent sample that committed a subsequent violent offence, the mean time to failure (reoffend) was 1556.81 days (*SD* = 814.69) with a minimum of 28 days and a maximum of 5629. Those 1061 offenders that committed a new non-violent offence, the mean time to failure was 772.63 days (*SD* = 875.62) with a minimum of 28 days and maximum of 5754 days to reoffend. Overall, these findings suggest that the non-violent sample recommitted a non-violent offence significantly quicker compared to violent offences.

Table 17

The Survival Time for the Arson Cohort, Violent and Non-violent Samples

Group	Recidivism Type	*m* (*SD*)	Min	Max
Arson	Arson	1765.74 (367)	28	4717
	Violent	1652.22 (794.51)	28	5967
	Non-violent	1120.78 (911.69)	28	5632
Violent	Violent	1320.41 (869.55)	28	6149
	Non-violent	966.44 (884.15)	28	5114
Non-violent	Violent	1556.81 (814.69)	28	5629
	Non-violent	772.63 (875.62)	28	5754

Note.

1. Total *n* = 86 (arson cohort/arson recidivism), *n* = 413 (arson cohort/violent recidivism), *n* = 864 (arson cohort/non-violent recidivism).
2. Total *n* = 747 (violent sample/violent recidivism), *n* = 955 (violent sample/non-violent recidivism).
3. *n* = 465 (non-violent sample/violent recidivism), *n* = 1061 (non-violent sample/non-violent recidivism).
4. Average time to fail measured in days over a 5-year "at-risk" follow-up period.
5. Min (minimum days to reoffend); Max (maximum days to reoffend).

Next, we conducted a one-way ANOVA to compare and assess the average time to reoffend (survival times) across the arson cohort, violent and non-violent samples. The mean comparisons for the between groups across the survival time (5-year follow-up) for the violent and non-violent recidivism types are shown. The *F* ratio for the violent survival time was [$F(2, 4389) = 62.49$, $p = 0.001$] and the *F* ratio for the non-violent survival time was [$F(2, 4389) = 56.17$, $p = 0.001$]. These findings indicate that the survival time over a 5-year follow-up for the violent and non-violent recidivism types was statistically significant between the three groups. This suggests that the three groups did not have the same average survival times to reoffend and were somewhat different between the two recidivism types (violent and non-violent).

In conclusion, the findings indicate that the arson group on average re-committed a non-violent offence significantly quicker compared to re-committing an additional violent offence or arson-related offence. Alternatively, repeat arsonists took the longest time on average to re-offend for arson-related offences compared to violent or non-violent offences. For the violent and non-violent groups, both on average re-committed a non-violent offence significantly quicker compared to violent offences. Overall, the findings suggest that the three groups (arson, violent and non-violent) did not have the same average time to fail and were somewhat different across the two main recidivism types (violent and non-violent). Although,

a consistent trend across all three groups is that they all reoffended more quicker for non-violent offences compared to violent offences. This finding suggests that an arson, violent and non-violent group of offenders will highly likely recommit non-violent crimes more-quicker compared to violent crimes and more so for arson crimes.

Pearson Correlations

Next, we conducted Pearson correlations using bivariate analyses which were used to examine the relationship between potential static risk variables and arson, violent and non-violent recidivism. To do this we used the arson cohort, violent and non-violent sample and relied on demographics and prior offence history data. This test will identify which static risk predictors are significantly correlated with arson, violent and non-violent recidivism. This test will also identify whether the arson cohort had similar or different risk predictors compared to the violent and non-violent samples. This test will help address one of the key research questions in this thesis which is to determine whether individuals who commit arson are qualitatively different from individuals with non-arson criminal histories (such as violent and non-violent offenders).

Table 18 presents the arson cohort correlations between demographics and prior offence-history variables and the three types of recidivism (arson, violent and non-violent). The table indicates that four variables were significantly correlated with arson recidivism: NZ European [$r = .054$, $p < .05$], first arson < 18-years [$r = .070$, $p < .001$], number of prior arsons [$r = .136$, $p < .01$] and vandalism [$r = .053$, $p < .05$]. These results suggest that arson offenders who were of NZ European descent, were young at the time of their first arson offence, had more prior arsons and vandalism offences were more likely to commit additional

arson offences during the 5-year follow-up period. Next, ten variables were significantly correlated with violent recidivism: NZ Māori [$r = .125$, $p < .01$], first arson < 18-years [$r = .098$, $p < .01$], first offence < 18-years [$r = .186$, $p < .01$], violent [$r = .178$, $p < .01$], vandalism [$r = .095$, $p < .01$], theft [$r = .101$, $p < .01$], drug [$r = .117$, $p < .01$], sexual [$r = .063$, $p < .05$], driving [$r = .089$, $p < .01$] and non-violent offences [$r = .143$, $p < .01$]. Last, nine variables were significantly correlated with non-violent recidivism: NZ Māori [$r = .136$, $p < .01$], first arson < 18-years [$r = .176$, $p < .01$], first offence < 18-years [$r = .283$, $p < .01$], violent [$r = .106$, $p < .01$], vandalism [$r = .081$, $p < .01$], theft [$r = .183$, $p < .01$], drug [$r = .115$, $p < .01$], driving [$r = .157$, $p < .01$] and non-violent offences [$r = .226$, $p < .01$]. Overall, these results indicate that for the arson cohort the violent and non-violent recidivism types had the same nine statistically significant demographics and offence history variables. Whereas, for arson recidivism, the two consistent correlational variables across all three recidivism types were: first arson < 18-years and vandalism (number of prior offences). These findings indicate that there are several similar variables across the two different recidivism types (violent and non-violent) and there are fewer (two) similar risk variables for arson recidivism.

Table 18

Correlations Between Static Variables and Arson, Violent and Non-violent Recidivism (Arson Cohort)

Static Variables	Arson	Violent	Non-violent
Demographics			
NZ Māori	-.016	.125**	.136**
NZ European	.054*	-.091**	-.040
Pacific Peoples	-.048	.032	-.051
Other (Ethnicity)	-.039	-.103**	-.159**
First arson < 18-years	.070**	.098**	.176**
Age at first arson offence	-.011	-.103**	-.270**
First offence < 18-years	.027	.186**	.283**
Age at first offence	-.019	-.139**	-.315**
Criterion Offence Type			
Multiple arsons	.051	.007	.028
Number Prior Offences			
Arson	.136**	-.038	-.074**
Violent	.027	.178**	.106**
Vandalism	.053*	.095**	.081**
Theft	.024	.101**	.183**
Drug	.004	.117**	.115**
Sexual	.026	.063*	.038
Driving	.007	.089**	.157**
Non-violent	.032	.143**	.226**

Note. $*p < 0.05$; $**p < 0.01$. This table presents Pearson correlations using bivariate analyses.

Table 19 presents the violent sample correlations across demographic and prior offence-history variables and the two types of recidivism (violent and non-violent). Ten variables were significantly correlated with violent recidivism, these were: NZ Māori [$r = .144$, $p < .01$], first violent offence < 18-years [$r = .151$, $p < .01$], first offence < 18-years [$r = .191$, $p < .01$], number of prior violent [$r = .118$, $p < .01$], vandalism [$r = .117$, $p < .01$], theft [$r = .088$,

$p < .01$], drug [$r = .074$, $p < .01$], sexual [$r = .054$, $p < .05$], driving [$r = .067$, $p < .05$] and non-violent offences [$r = .118$, $p < .01$]. These results suggest that violent offenders who were of NZ Māori descent, either had their first violent offence < 18-years or their first offence < 18-years and had more prior violent, vandalism, theft, drug, sexual, driving and non-violent offences were more likely to commit additional violent offences during the follow-up period. The findings from the violent sample suggest that the violent and non-violent recidivism types share the same statistically significant demographics and prior offence-history variables (except the sexual offence). Of comparison, the statistically significant variables for violent recidivism (in the arson cohort) and the violent sample were the same. Also, the statistically significant variables for non-violent recidivism (in the arson cohort) and the violent sample were the same.

Table 19

Correlations Between Static Variables and Violent and Non-violent Recidivism (Violent Sample)

Static Variables	Violent	Non-violent
Demographics		
NZ Māori	.144**	.159**
NZ European	-.067*	-.012
Pacific Peoples	-.041	-.094**
Other	-.122**	-.187**
First violent < 18-years	.151**	.153**
Age at first violent offence	-.254**	-.299**
First offence < 18-years	.191**	.246**
Age at first offence	-.227**	-.334**
Number of Prior Offences		
Violent	.118**	.092**
Vandalism	.117**	.097**
Theft	.088**	.223**
Drug	.074**	.133**
Sexual	.054*	.048
Driving	.067*	.181**
Non-violent	.118**	.264**

*Note. *p < 0.05; **p < 0.01.* This table presents Pearson correlations using bivariate analyses.

Table 20 presents the non-violent sample correlations between demographics and prior offence-history variables and the two types of recidivism (violent and non-violent). Eight variables were significantly correlated with non-violent recidivism: NZ Māori [$r = .119$, $p < .01$], first non-violent offence < 18-years [$r = .252$, $p < .01$], first offence < 18-years [$r = .269$, $p < .01$], number of prior violent [$r = .092$, $p < .01$], vandalism [$r = .071$, $p < .01$], theft [$r = .109$, $p < .01$], driving [$r = .053$, $p < .05$] and non-violent offences [$r = .065$, $p < .05$]. These results suggest that non-violent offenders who were of NZ Māori descent, either had

their first non-violent offence < 18-years or their first offence < 18-years and had more prior violent, vandalism, theft, driving and non-violent offences were more likely to commit additional non-violent offences during the follow-up period.

Further, these findings indicate the same eight statistically significant demographics and offence-history variables across both recidivism types (violent and non-violent). In comparing the arson cohort with the non-violent sample (violent recidivism type) both groups had the same statistically significant variables (except drug and sexual offences). For non-violent recidivism between both groups (arson cohort and non-violent sample) both groups have the same statistically significant variables (except drug). Further, the prior sexual variable was positively correlated in the arson cohort (.063*) and the violent sample (.054*) for violent recidivism but was negatively correlated for the non-violent sample (-.013).

Table 20

Correlations Between Static Variables and Violent and Non-violent Recidivism (Non-violent Sample)

Static Variables	Violent	Non-violent
Demographics		
NZ Māori	.146**	.119**
NZ European	-.091**	-.019
Pacific Peoples	.028	-.024
Other	-.152**	-.184**
First non-violent < 18-years	.268**	.252**
Age at first non-violent offence	-.251**	-.350**
First offence < 18-years	.285**	.269**
Age at first offence	-.265**	-.386**
Number of Prior Offences		
Violent	.174**	.092**
Vandalism	.082**	.071**
Theft	.122**	.109**
Drug	.001	.020
Sexual	-.013	-.052*
Driving	.066*	.053*
Non-violent	.071**	.065*

*Note. *p < 0.05; **p < 0.01.* This table presents Pearson correlations using bivariate analyses.

Overall, the results from the correlational analyses indicate that certain demographics and prior offences predict arson, violent and non-violent recidivism at statistical significance (2-tailed test). The findings indicate that the correlations were overall stronger for violent and non-violent recidivism than for arson recidivism. The reduced magnitude of the correlations for arson recidivism likely reflects the lower base rate of 5.87% compared with violent and non-violent recidivism which had much higher base rates of 51.02% and 72.47%,

respectively. Irrespective of the base rates, the correlations presented do provide particularly valuable information on whether certain risk variables (demographics and prior offence history) differ across the three offender groups in terms of their predictive relationship with arson, violent and non-violent recidivism. Identifying the type of relationships discussed here are important and fundamental steps towards developing preliminary actuarial risk prediction models for recidivism. Further, this type of analysis addresses one of the research questions in this thesis of whether individuals who commit arson are qualitatively different from individuals with non-arson criminal histories. This will be discussed in more detail in the discussion section of this chapter.

The Development of the Arson Actuarial Tool

The next step in the analyses relied on the information provided (descriptive statistics and crosstabs) to test whether the original Edwards and Grace (2014) arson actuarial risk model can be replicated using the current arson cohort. To achieve this, we calculated scores for the same 10-point arson risk classification scale from the previously developed Edwards and Grace (2014) study. We relied on the arson cohort model scores to generate the values for the arson model categories. These scores were based on the sum of the same three predictor variables which were used in the Edwards and Grace (2014) actuarial model, these were; first arson < 18-years, multiple arsons at the criterion date and number of prior vandalism offences. These same three predictor variables were coded as 0-3, 0-5 and 0-2, respectively. The defined risk distribution scales for the classification scale varied from 0 to 10, with lower risk scores (0 -3) indicating low-risk and higher risk scores (7-10) indicating high-risk for arson recidivism.

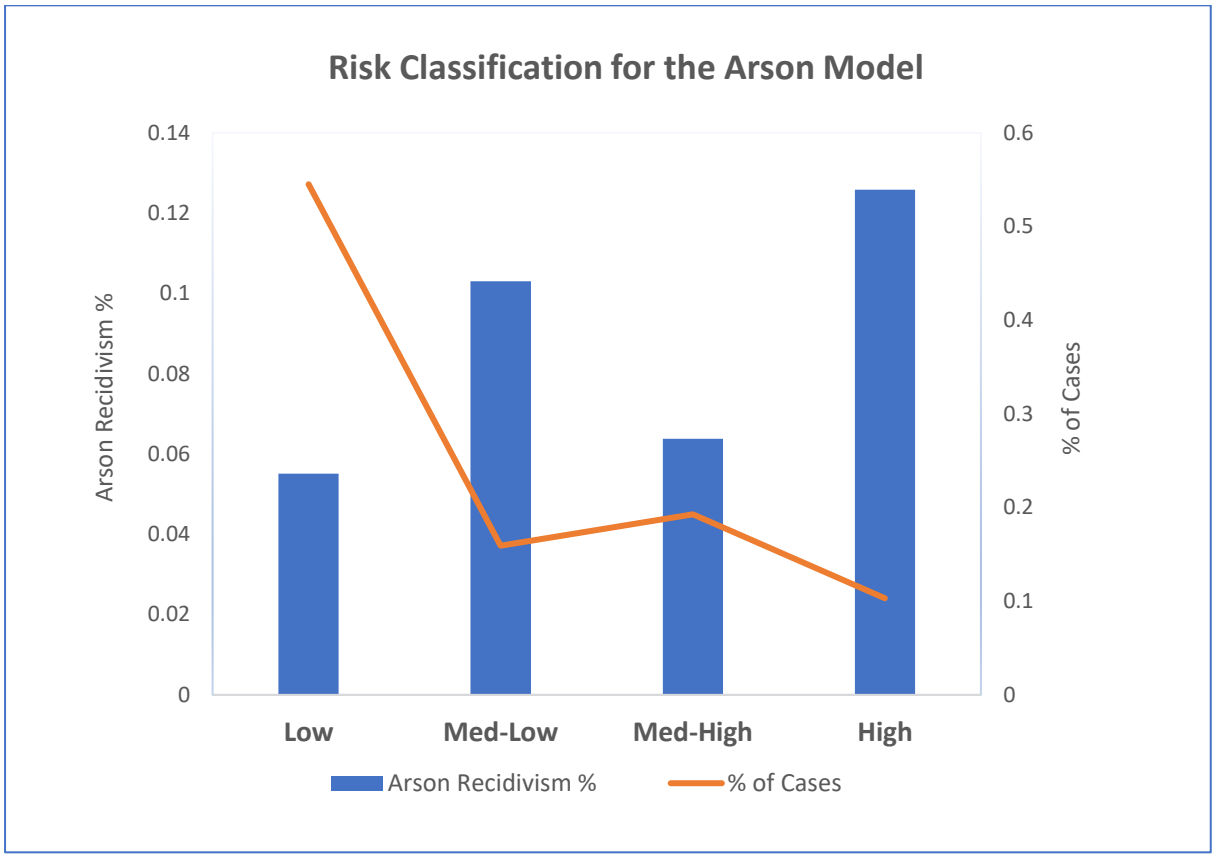
To develop the risk scale for the current arson cohort over the entire study (n = 1430), we constructed the same four risk bands using crosstabs, ranging from 0 to 3 and using the sum of the arson model scores from the current arson cohort scores and the same criteria as the Edwards and Grace (2014) study: low (0 to 1), medium-low (2 to 3), medium-high (4 to 6) and high (7 to 10). These four risk bands were ranked as low = 0, medium-low = 1, medium-high = 2 and high = 3, respectively. Figure 9 presents the proportion of arson recidivists against the percentage of cases in each of the four risk bands. The percentage of the sample (% of cases) in the four risk bands was: 55% (n = 798/1430) for low, 16% (n = 233/1430) for medium-low, 19% (n = 282/1430) for medium-high and 10% (n = 151/1430) for high. The visual presentation of the figure indicates that the percentage of cases decrease as the risk bands increased from low to medium-low, followed by a slight increase in the percentage of cases from medium-low to medium-high and a decrease in cases as the risk band increases from medium-high to high. Next, the proportion of arson recidivists (arson recidivism %) over the entire study (n = 105) is broken down into the four distinct risk bands: 6% (n = 44/105) for low, 10% (n = 24/105) for medium-low, 6% (n = 18/105) for medium-high and 13% (n = 19/105) for high.

Overall, the findings from the generated risk scale indicates that the proportion of arson recidivists increase as the risk bands increase from low to medium-low, decreases in arson recidivists from medium-low to medium-high and about a two-fold increase in arson recidivists from medium-high to high. The correlation between the arson model score with arson recidivism for the current arson cohort was = .71** (p < 0.01), n = 1430. The predictive accuracy for the current arson cohort was AUC = .60. The correlation between the arson model score with arson recidivism from the original Edwards and Grace (2014) study was = .149** (p < 0.01), n = 1250. The predictive accuracy for the previous Edwards and Grace

(2014) study was AUC = .68. These results indicate that the predictive accuracy between both studies (previous and current) was higher in the original study compared to the recent arson cohort, AUC = .60 vs AUC = .68. This suggests that the accuracy was reduced for the current arson cohort compared to the previous Edwards and Grace (2014) study. Both studies are statistically significant with their AUC's, although the current arson cohort does show a reduction in the AUC score by .08. The correlation between the arson model score with arson recidivism between both studies was .71** vs .149**. This finding suggests that the original Edwards and Grace (2014) study had a stronger (more than doubled) statistically significant correlation between the arson model score and arson recidivism compared to the current arson cohort. A key finding from this analysis is that the original Edwards and Grace (2014) model provides a more accurate actuarial measure of choice and with a stronger correlation with arson recidivism compared to the current preliminary model.

Figure 9

Replicated Risk Classification and Recidivism Rates for the Arson Model



Next, an independent-samples *t*-test was conducted to determine any significant differences between the arson model scores from the original Edwards and Grace (2014) study and the current arson cohort. This test will identify whether the two cohorts of arson offenders had similar or different independent mean scores for the 10-point actuarial scale. The arson model scores relied on the same three predictor variables from the original Edwards and Grace (2014) study; first arson offence < 18-years, multiple arsons at the criterion offence date and number of prior vandalism offences. Table 21 presents the overall mean comparisons between the Edwards and Grace (2014) arson study and the current study. The results indicate that this test failed to reach any statistical significance, $t(2678) = 1.38$, $p = 0.17$, $d = 0.05$. This suggests that there were no significant differences between the arson model scores from the original Edwards and Grace

(2014) study (n = 1250, m = 2.00, SD = 2.25) and the arson model scores from the present study (n = 1430, m = 2.13, SD = 2.61). This indicates that the two arson cohorts had comparable and similar arson model scores from their respective 10-point actuarial scales.

Table 21

Arson Risk Model Scores from the Original Edwards and Grace (2014) Study and the Current Arson Study

	Arson Risk Model Scores		
Arson Cohort	***n***	***m*** ***SD***	***m* (Std. Error)**
2014 Study	1250	2.00 (2.25)	0.06
Current Study	1430	2.13 (2.61)	0.07

ARSON, VIOLENT AND NON-VIOLENT PREDICTIVE MODELS

One of the main goals of this study was to develop and compare risk predictive models for arson, violent and non-violent recidivism. This includes investigating the variables used to develop these preliminary models across the 3 different groups. To do this, we used logistic regression (binary) predictions to generate the best fitting models for each recidivism type for each offender group. We also relied on stepwise regression to calculate pooled models for violent and non-violent recidivism types for each group. These were subsequently compared against the actual group data and any similarities or differences were recorded. In total, seven predictive models were developed from this analysis: three recidivism models from the arson cohort, two models from the violent sample and two models from the non-violent sample. We employed the Hosmer-Lemeshow goodness-of-fit method (Archer, Lemeshow, & Hosmer, 2007) and used forward conditional binary stepwise with the same predictor variables for each group (except the arson recidivism model which used arson-specific predictor

variables). The predictor variables were entered for each model with a $p < .05$ criterion for inclusion at each step. The final predictors from the arson cohort to develop the best fitting arson, violent and non-violent models are presented in Table 22.

Predictive Models (Arson Cohort)

- Arson Model: The first model for predicting arson recidivism included two significant predictors: first arson < 18-years and number of prior arson offences. The results suggest that those offenders who were young at the time of the criterion arson offence and had more prior arson offences had significantly greater rate for arson recidivism.
- Violent Model: The second model for predicting violent recidivism included three significant predictors: age at first arson offence, age at first offence < 18-years and number of prior violent offences, these three predictors had a significantly greater rate for violent recidivism.
- Non-violent Model: The third model for predicting non-violent recidivism included six significant predictors: age at first arson offence, age at first arson < 18-years, age at first offence < 18-years, number of prior non-violent, prior theft and prior vandalism offences, had a significantly greater rate for non-violent recidivism.

Table 22

The Arson Cohort Final Predictor Variables for the Arson, Violent and Non-violent Models

Arson Cohort	Predictor Variables	*B*	S.E.	Wald	df	Exp(*B*)
Arson Model	First arson < 18-years	0.65**	0.26	6.15	1	1.92
	Number prior arsons	2.12***	0.53	15.91	1	8.34
Violent Model	Age at first arson offence	-0.03***	0.01	13.40	1	0.97
	Age at first offence < 18-years	0.73***	0.12	35.95	1	2.07
	Number prior violent	0.93***	0.19	24.11	1	2.54
Non-violent Model	Age at first arson offence	-0.06***	0.01	70.16	1	0.94
	First arson < 18-years	0.59*	0.24	5.86	1	1.80
	Age at first offence < 18-years	0.46**	0.17	6.98	1	1.58
	Number prior non-violent	1.84***	0.26	50.78	1	6.32
	Number prior theft	-0.92***	0.28	11.05	1	0.40
	Number prior vandal	-0.84*	0.35	5.87	1	0.43

Note. *$p < .05$; **$p < .01$, ***$p < .001$. Logistic regression (binary) was used to develop each model. The predictor variables were entered with a $p < .05$ criterion for inclusion.

Predictive Models (Violent Sample)

- Violent Model: The first model for predicting violent recidivism included three significant predictors: age at first violent offence, age at first offence < 18-years and number of prior vandalism offences. These results suggest that offenders who were young at the time of their first violent offence, age at their first offence and had more prior vandalism offences, had a significantly greater rate for violent recidivism.
- Non-violent Model: The second model for predicting non-violent recidivism included four significant predictors: age at first violent offence, first violent offence < 18-years, number of prior violent and prior non-violent offences, these had a significantly greater rate for non-violent recidivism.

The final predictors from the violent sample to develop the best fitting violent and non-violent models are presented in Table 23.

Table 23

The Violent Sample Final Predictor Variables for the Violent and Non-violent Models

Violent Sample	Predictor Variables	*B*	S.E.	Wald	df	Exp(*B*)
Violent Model	Age at first violent offence	-0.05***	0.01	47.76	1	0.95
	Age at first offence < 18-years	0.38**	0.12	9.44	1	1.46
	Number prior vandal	0.92**	0.36	6.46	1	2.52
Non-violent Model	Age at first violent offence	-0.07***	0.01	70.64	1	0.94
	First violent < 18-years	0.47**	0.18	6.74	1	1.60
	Number prior violent	-1.18***	0.26	20.97	1	0.31
	Number prior non-violent	1.30***	0.14	89.18	1	3.67

Note. **$p < .01$, ***$p < .001$. Logistic regression (binary) was used to develop each model. The predictor variables were entered with a $p < .05$ criterion for inclusion.

Predictive Models (Non-violent Sample)

- Violent Model: The first model for predicting violent recidivism included four significant predictors: age at first offence, age at first offence < 18-years, number of prior violent and prior drug offences, these predictors had a significantly greater rate for violent recidivism.
- Non-violent Model: The second model for predicting non-violent recidivism included two significant predictors: age at first offence and age at first offence < 18-years. These results suggest that offenders who were young at the time of their first offence and under eighteen years of age had a significantly greater rate for non-violent recidivism. Of note, the number of prior non-violent offence variable was removed as a covariate from the regression analyses. This was due to the strong correlation (high

intercorrelations) between the independent variables (non-violent offences and the age-related variables) which produced multicollinearity affects.

The final predictors from the non-violent sample to develop the best fitting violent and non-violent models are presented in Table 24.

Table 24

The Non-violent Sample Final Predictor Variables for the Violent and Non-violent Models

Non-violent Sample	Predictor Variables	*B*	S.E.	Wald	df	Exp(*B*)
Violent Model	Age at first offence	-0.07***	0.01	26.68	1	0.93
	Age at first offence < 18-years	0.71***	0.15	23.31	1	2.03
	Number prior violent	1.36***	0.26	26.42	1	3.88
	Number prior drug	-1.23***	0.31	15.47	1	0.29
Non-violent Model	Age at first offence	-0.08***	0.01	72.93	1	0.92
	Age at first offence < 18-years	0.81***	0.18	20	1	2.25

Note. ***$p < .001$. Logistic regression (binary) was used to develop each model. The predictor variables were entered with a $p < .05$ criterion for inclusion.

Overall, the arson specific model from the arson cohort produced two statistically significant final predictor variables; first arson < 18-years (*B* = 0.65**) and number of prior arsons (*B* = 2.12***). This arson model is unique and specific to the arson cohort due to the other two samples in the study not having any prior or post arson offences. For comparison, the final predictor variables in the arson model from the original Edwards and Grace (2014) study were first arson < 18-years (*B* = 0.92**), multiple arsons (*B* = 1.18***) and number of prior vandalism (*B* = 0.34*). In comparing the arson models from both studies, the two similar predictor variables identified from the two arson models were: first arson < 18-years and number of prior arsons/multiple arsons. Of interest, the number of prior arsons from the Edwards and Grace (2014) study showed a statistically significant result for the correlation

between arson recidivism and number of prior arsons (.06*). However, that specific variable was not strong enough to be included in their original model. Multiple arsons (.12**) was included in the original model, however, multiple arsons in the current arson cohort was not a statistically significant correlation with arson recidivism (.051) and was not included in the best fitting model for the current arson model.

Of note, the number of prior arsons and multiple arsons predictor variable may be viewed as substantively the same predictor variable across the arson models in both studies, however there is a slight difference that determines these two predictor variables. Based on the study design, what differentiates these two predictor variables is the criterion hearing date. That is, these two variables were based on when the individual's prior arsons were committed. By this, did the individual appear at their first arson court hearing date for one arson charge only or did the individual appear on multiple arson charges at their first arson court hearing appearance. As discussed, with reference to the arson classification table (by style and type), the type of individual most likely to have committed multiple arsons are those who commit double, triple, mass, spree or serial type arsons.

In contrast, individuals with a single arson charge at their first court hearing date were those to have only committed one arson and would exclusively fit the "number of prior arsons" variable not the "multiple arson" variable. Next, the number of prior vandalism offences in the Edwards and Grace (2014) study did not make final inclusion in the current best fitting arson cohort model. Even though this variable in the arson cohort produced a significantly strong correlation between arson recidivism and vandalism (.053*) it was not strong enough to be included in the current arson model. However, surprisingly the prior vandalism variable made it in the violent specific model (B = 0.92**) from the violent sample and in the arson

cohort non-violent model (*B* = -0.84*). For the age-related predictor variables: first arson < 18-years, age at first arson and age at first offence < 18-years were common predictor variables within the three models from the arson cohort. For the number of prior offence predictor variables; the number of prior violent offence featured in both the violent models from the arson cohort and non-violent sample. Whereas the number of prior vandalism offence variable featured in the violent model from the violent sample. Surprisingly, the number of prior non-violent predictor variable was not featured in the non-violent sample non-violent model but did make inclusion in the other two non-violent models.

The next step after developing the seven predictive models was to compute the area under the ROC curves (AUC) for each model. This test is a standard measure which identifies the predictive accuracy for each model. This was achieved by saving the identified predicted probability from each model and using this as the test variable. The state variable for each ROC curve is the reconviction 5-years variable (arson, violent and non-violent reconviction data). First, the AUC scores for the arson cohort predicting arson, violent and non-violent recidivism were .61, .66 and .74, respectively. Second, the AUC scores for the violent sample predicting violent and non-violent recidivism were .66 and .74, respectively. Last, the AUC scores for the non-violent sample predicting violent and non-violent recidivism were .72 and .75, respectively.

Of interest, the pooled AUC scores for the arson cohort predicting violent and non-violent recidivism were .65 and .70, respectively. The pooled AUC values for the violent sample predicting violent and non-violent recidivism were .64 and .71, respectively. Last, the pooled AUC scores for the non-violent sample predicting violent and non-violent recidivism were

.71 and .74, respectively. The AUC scores for the developed models in both studies are presented in table 25.

These findings suggest that the arson and violent models from the arson cohort and the violent model from the violent sample achieved reasonably moderate levels of predictive accuracy. Further, the violent model from the non-violent sample achieved reasonably strong levels of predictive accuracy. The non-violent models from the arson cohort, violent sample and non-violent sample all achieved reasonably strong levels of predictive accuracy. Of interest, the AUC results for the violent and non-violent models developed from the arson cohort and the AUC's for violent and non-violent models developed from the violent sample provided the same levels of predictive accuracy. The AUC scores from this arson cohort were somewhat less than the AUC scores obtained from the original Edwards and Grace (2014) study; arson .61 vs .70, violent .66 vs .72 and non-violent recidivism .74 vs .75, respectively.

Table 25

The AUC Scores for all Developed Models from the Current and Edwards and Grace (2014) Study

Group	Recidivism Type	AUC Score (2014 Study)	AUC Score (Current Study)
Arson	Arson	0.70	0.61
	Violent	0.72	0.66
	Non-violent	0.75	0.74
Violent	Violent	-	0.66
	Non-violent	-	0.74
Non-violent	Violent	-	0.72
	Non-violent	-	0.75

Note. Model accuracies was measured in terms of the area under the Receiver Operating Characteristics (ROC) curve (Rice & Harris, 1995). An area under the curve (AUC) score above .71

represents a large effect size (Rice & Harris, 2005). The Edwards and Grace (2014) study did not have violent and non-violent offender groups therefore no AUC scores were obtained.

Next, we compared the ROC scores between the arson cohort, violent and non-violent sample. The purpose for this type of analysis was to test whether the predictors of recidivism for the arson cohort are different or similar from the predictors of recidivism for the violent non-violent sample. By comparing the ROC scores between the three groups we attempt to understand whether arson offenders represent a unique or special subtype of offenders compared to violent and non-violent offenders. Alternatively, this test may determine that there is no significant difference between any of the predictors of recidivism and the three unique groups (arson, violent and non-violent offenders).

To compare the ROC scores between the arson cohort, violent and non-violent samples we used the pROC package and the DeLong test to compare the AUC values and z test scores between the three groups (DeLong et al., 1988). In total six models were tested, the violent and non-violent models from the arson cohort and the violent and non-violent models from the violent and non-violent groups, these are presented in table 26. The DeLong test identified that the main significant difference between the three groups was the non-violent model from the non-violent sample ($z = 2.69$, $p < 0.007$). The non-violent sample results for both the violent and non-violent models were overall stronger compared to the arson cohort and violent sample. Further, negative z test scores were obtained for the violent models from the arson cohort and violent sample; arson ($z = -0.73$, $p < 0.47$), violent ($z = -0.16$, $p < 0.88$) and positive z test scores were obtained for the non-violent models from the arson cohort and violent sample; arson ($z = 1.16$, $p < 0.25$ and $z = 0.74$, $p < 0.46$).

Table 26

The Arson Cohort, Violent and Non-violent Sample z Test and p Values for the Violent and Non-violent Models

Group	Recidivism Type	*z*	*p*
Arson	Violent	-0.73	0.47
	Non-violent	1.16	0.25
Violent	Violent	-0.16	0.88
	Non-violent	0.74	0.46
Non-violent	Violent	1.65	0.0996
	Non-violent	2.69	0.007

Note. *p* value (two tailed) test.

Next, we computed the mean comparisons between the arson cohort 1 and arson cohort 2 samples across various age-related and offence history variables. The purpose of table 27 is to provide an indication of mean comparisons between both arson cohorts across the three age-related variables and eight offence history variables. The findings indicate that the arson cohort 2 group were older across all three age-related variables compared to the arson cohort group. That is, the arson cohort 2 group were approximately 3-years older compared to the arson cohort 1 group on all three age-related variables. The f ratio results for all three age-related variables were statistically significant at the $p < .001$ level. This finding indicates that individuals in the second arson cohort were older on average compared to the individuals in the first arson cohort.

For the eight-offence history variables (number of prior convictions), the arson cohort 1 group had higher means for five of the eight offence history variables, these were; vandalism, theft, drugs, sexual and non-violent related offences. In contrast, the arson cohort 2 group had higher means for the remaining three offence history variables; arson, violent and driving-related offences. The f ratio results for the offence history variables were all statistically

significant (except for the non-violent variable). We can conclude from these findings is that the arson cohort 2 sample committed more prior arson convictions on average than the arson cohort 1 sample. Further, the arson cohort 2 sample committed more prior violent and driving convictions compared to the first arson cohort sample.

Table 27

Mean Comparisons Between the Arson Cohort 1 and Arson Cohort 2 Samples Across Age-related and Offence History Variables

Variables	Arson Cohort 1	Arson Cohort 2	
	m ***SD***	***m*** ***SD***	***F***
Age at criterion	23.84 (8.57)	26.81 (10.04)	76.12***
Age at first arson offence	23.34 (8.48)	26.47 (9.90)	69.14***
Age at first offence	18.60 (5.79)	21.74 (7.92)	104.84***
Offence History (Prior Convictions)			
Arson	0.00 (0.11)	0.16 (0.88)	161.59***
Violent	1.06 (2.08)	1.13 (2.58)	6.83**
Vandalism	0.69 (1.54)	0.48 (1.65)	8.05**
Theft	7.54 (13.16)	4.56 (10.74)	30.54***
Drug	1.46 (3.09)	0.77 (1.96)	66.10***
Sexual	0.09 (0.47)	0.06 (0.39)	9.72**
Driving	1.16 (2.59)	1.52 (3.46)	31.62***
Non-violent	10.85 (15.34)	9.07 (16.48)	0.97

Note. **$p < .01$, ***$p < .001$.

Next, we provide the ethnicity breakdown for the arson cohort 1 and arson cohort 2 samples in table 28. The table suggest that for both cohorts, NZ European/Caucasian were the predominant ethnic groups followed by NZ Māori, Pacific Islands/Polynesian and a small proportion of other (which includes other ethnic groups). The ethnic percentages across both arson cohorts 1 and 2 were relatively similar; NZ European/Caucasian: 64.40% and 58%, NZ Māori: 30.32% and 32%, Pacific Islands/Polynesian: 4.40% and 6% and other ethnic groups:

0.88% and 4%. Overall, about two-thirds of the sample were of NZ European/Caucasian descent, about one-third of NZ Māori decent and the remaining 5% to 10% between both arson cohorts belonged to Pacific Islands/Polynesian and other ethnic groups.

Table 28

Ethnicity Breakdown Between the Arson Cohort 1 and Arson Cohort 2 Samples

Ethnicity	Arson Cohort 1		Arson Cohort 2	
	n	***%***	***n***	***%***
NZ Māori	379	(30.32)	470	(32)
European/Caucasian	805	(64.40)	849	(58)
Pacific Islands/Polynesian	55	(4.40)	82	(6)
Other	11	(0.88)	63	(4)

Note. Total $n = 1250$ (arson cohort 1), $n = 1464$ (arson cohort 2).

Linear Discriminant Analysis (LDA)

Unlike the original Edwards and Grace (2014) study, LDA will be tested against the current arson cohort, the group of violent offenders and the group of non-violent offenders. The purpose of this analysis was to classify the seven prior offence history variables into groups and identify which variables if any best predicts which recidivism types for the arson, violent and non-violent groups. This type of analysis evaluated seven prior offence history variables as predictors of recidivism against the three groups. The prior offence history variables were number of prior; violent, driving, drug, theft, vandalism, sexual and non-violent offences. These variables were the same variables used in the previous ANOVA tests, but instead log variables were used for the purpose of this analysis. This analysis used the stepwise method and relied on the leave-one-out classification.

Discriminant Function Plot

To determine the extent of separation if any between each of the three groups (arson, violent and non-violent) we develop a discriminant function plot. A visual presentation would indicate where the arson group is situated on the plot in relation to the violent and non-violent groups. The three groups are spaced and separated along various discriminant functions according to their respective group centroids (mean discriminant scores for each group). The X-axis is represented by discriminant function 1 and the Y-axis is represented by discriminant function 2 and the centroids of the three groups are plotted along the axes. In sum, the centroid plots provide an indication of how groups are separated by each discriminant function. Figure 10 presents a plot of the three centroids for the arson, violent and non-violent groups against the two discriminant functions (1 and 2).

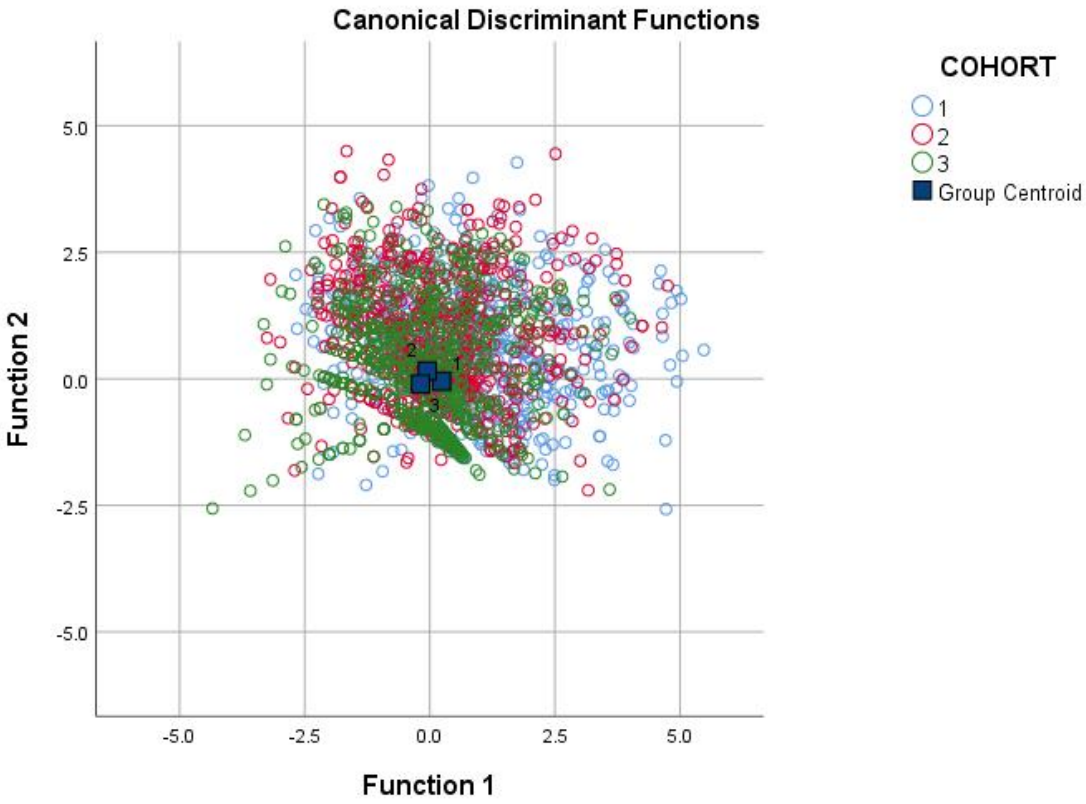
The results indicate that there is a minimal difference or separation between each group centroid along the discriminant function axis. This suggests that all three groups were remarkably close to each other on both the X-axis (function 1) and the Y-axis (function 2). Given that there is minimal separation and distance between each group classifying the arson group from the violent and non-violent group is somewhat limited.

Overall, these findings suggest that based on the prior criminal offence history variables (violent, driving, theft, vandalism, sexual and non-violent offences) there is much overlap between the offences and the three groups of offenders (arson, violent and non-violent). Thus, there is minimal separation that differentiates an arson offender from a violent offender or a non-violent offender. This analysis concludes that we have limited capacity in accurately

classifying or identifying any group of offenders whether they are arson offenders, violent offenders and non-violent offenders based on prior criminal convictions.

Figure 10

A Plot of the Three Centroids for the Arson, Violent and Non-violent Groups Against the Two Discriminant Functions



Classification Statistics

Next, a classification procedure was conducted to assign cases into respective groups and determine which groups if any could be correctly classified based on the prior offence history variables. The aim of this procedure was to correctly classify the arson cohort against the violent and non-violent group and if so, what are the levels of accuracy. The classification results were provided for the arson, violent and non-violent groups with reference to the

original and cross-validated scores. The rows in table 29 represent the actual group membership and the columns represent the predicted group membership. Within each cell, the number (count) and percent of the cases correctly classified are presented in table 29. The results indicate that for the arson sample using the original scores 31.2% were predicted, for the violent group, 27.5% predicted and for the non-violent group, 61.2% were predicted. A cross validation test was conducted and the following results were provided; arson 31%, violent 27.3% and non-violent, 60.9%. In this three-group solution, the identification for each group at the level of chance is 33.3%.

The results from the discriminant function concludes that we cannot successfully differentiate the three groups of offenders from each other. In particular, the arson offender and the violent offender, the identification of the two groups were at levels lower than by chance, thus, these predictions for identification are not accurate. This suggests we have better odds of classifying these two groups by chance levels rather than by statistical methods such as LDA. Although, we can classify group membership of non-violent offenders close to two-thirds level of chance, however, additional analyses cannot be conducted due to the low scores obtained from the arson and violent groups.

The benefit of these findings from this classification procedure is that there is nothing particularly special or unique about a group of arson offenders compared to a group of violent offenders and a group of non-violent offenders. Thus, prior criminal convictions among the three groups are relatively similar and appear largely to overlap each other. These findings help put in context one of the research questions of whether individuals who commit arson offences are qualitatively different from individuals who do not commit arsons (those with non-arson criminal histories). This will be addressed in the discussion section of this chapter.

Table 29

The Classification Results for the Original and Cross-validated Scores for the Arson, Violent and Non-violent Samples

			Predicted Group Membership			
		Group	**Arson**	**Violent**	**Non-violent**	**Total**
Original	*n*	Arson	457	265	742	1464
	n	Violent	313	403	748	1464
	n	Non-violent	287	281	896	1464
	%	Arson	31.2	18.1	50.7	100.0
	%	Violent	21.4	27.5	51.1	100.0
	%	Non-violent	19.6	19.2	61.2	100.0
Cross-validated	*n*	Arson	454	268	742	1464
	n	Violent	314	400	750	1464
	n	Non-violent	290	282	892	1464
	%	Arson	31.0	18.3	50.7	100.0
	%	Violent	21.4	27.3	51.2	100.0
	%	Non-violent	19.8	19.3	60.9	100.0

Overall, the findings from the linear discriminate analysis confirmed that we cannot successfully differentiate the three groups of offenders, particularly for the arson offenders and the violent offenders, identifying these two groups were at levels lower than by chance. One of the goals of the present study was to identify ways in which we can clearly distinguish an arson offender from other types of offenders such as violent and non-violent offenders. Based on these findings we are unable to clearly distinguish or classify an arson offender from a violent offender or a non-violent offender based on prior criminal histories. Given there is minimal separation that differentiates each group to classify the arsonists from the violent and non-violent group indicates that there is nothing particularly unique or special for each offender group. The results suggest that arson offenders may be viewed as criminally versatile who commit violent, driving, theft, vandalism, sexual and non-violent offences as

with the violent and non-violent offenders who commit similar types of crimes. To conclude, we cannot distinguish or accurately classify these groups based on their previous criminal convictions. Therefore, individuals who commit arson are not qualitatively different or unique from individuals with non-arson criminal histories, such as violent offenders and non-violent offenders.

DISCUSSION

The Research Questions

This current study further addresses two of the key foundational and critically important conceptual questions explored throughout this thesis. The first research question addressed is whether actuarial tools can be created to predict rare offending events such as arson offending? The final risk predictors used to develop the arson predictive model (in this current study) were first arson under 18-years and prior arson offences. The arson predictive model provided an AUC score of .61, indicating a low level of predictive accuracy. This score is somewhat lower than the previous Edwards and Grace (2014) study of .68. Nonetheless, these two risk predictors have been identified by Field (2015) as reasonably well supported risk factors. Therefore, the utility of this additional arson predictive model is not in serious doubt and does provide additional support and confidence for developing empirically based actuarial models for predicting arson reoffending.

One of the main aims of this chapter was to assess the generalisability and utility of the original Edwards and Grace (2014) actuarial tool. To achieve this, we replicated the Edwards and Grace (2014) study and developed an additional second-generation actuarial tool based

on a new non-overlapping arson cohort series (1998-2008). It was determined that the second-generation actuarial tool developed in this present study can indeed predict rare offending events such as arson recidivism, but it did provide a low level of predictive accuracy. The AUC score for the replicated tool was .60. This finding suggests that the scale is operating at a low level of accuracy and is somewhat lower than the previous scale of .68. Although some reduction in predictive accuracy would be expected when generalizing to a new sample, the decrease in accuracy may have been due in part to the methodology and how the index offence was defined.

For example, for every individual in the first study, the authors captured the start of their arson criminal careers. Whereas, in this current study, individuals were investigated at some point in time during their arson criminal careers and not necessarily at the start. Nonetheless, replicating the actuarial tool does provide valuable information for supporting empirical-based approaches to predict rare events such as arson recidivism. The current findings support and complements the Edwards and Grace (2014) study and further promotes a simple, user-friendly and automatically scored operationalised risk classification tool for NZ convicted arson offenders.

The second research question addressed is determining whether individuals who commit arson offences are qualitatively different from individuals with non-arson criminal histories? We attempted to classify and distinguish arson, violent and non-violent offenders based on prior offence histories. The findings from an LDA test indicate that arson offenders are not a unique subtype of offenders compared to violent and non-violent offenders and that generally arsonists are like other types of offenders (including those with non-arson criminal backgrounds). Thus, arson, violent and non-violent offenders are relatively similar in terms of

their prior offence histories and do commit similar criminal offences. However, when it came to differentiating arson repeat or arson recidivist offenders (as discussed in chapter 2) arson recidivists are somewhat qualitatively different from violent recidivists and non-violent recidivists but more so for violent recidivists. This is based on the scientific empirical evidence presented in the first in which the risk predictors used to predict arson recidivism are somewhat different to the risk predictors used to predict violent and non-violent recidivism.

The primary objective of this current study was to replicate the previously published work by Edwards and Grace (2014) to assess the generalisability and utility of their original developed actuarial tool. In this second study, we identified a cohort of 1464 individuals convicted of an arson offence in NZ between 1998 and 2008. We also identified a random sample of 1464 individuals convicted of a violent offence and a random sample of 1464 individuals convicted of a non-violent offence in NZ during the same period. One of the main objectives of this study was to investigate arson, violent and non-violent recidivism over a 5-year follow-up period. Following this, we developed and compared predictive models for arson, violent and non-violent recidivism (within each of the samples and across the three different samples). Next, we replicated the second-generation actuarial arson risk prediction model and finally we attempted to classify arson, violent and non-violent offenders based on prior offence histories.

During the follow-up, 5.87% of the arson cohort were convicted of a new arson offence; recidivism rates for violent and non-violent recidivism (arson cohort) were 28.21% and 59.02%, respectively. This arson recidivism finding is similar to the 6.2% identified in the Edwards and Grace (2014) study and 5.3% identified in the Ducat et al., (2015). For the

violent sample, 51.02% committed a new violent offence and 65.23% committed a new non-violent offence. For the non-violent sample, 31.76% committed a new violent offence and 72.47% committed a new non-violent offence. In addition, we identified the average survival time (in days) for the three samples and across the three recidivism types. For arson recidivists, the mean time to failure was 1765.74 days. Those arson offenders that committed a new violent offence, their mean time to failure was 1652.22 days and those that committed a new non-violent offence their mean time to failure was 1120.78 days.

These findings suggest that the arson cohort had recommitted a non-violent offence significantly more-quicker compared to violent and arson offences. Thus, arson offences took the longest time to re-offend compared to the other two recidivism types. This finding is consistent with previous work (Ducat et al., 2015) that firesetters are reconvicted for other types of offences and have higher recidivism rates compared to arson reconviction rates, which are far less.

For the violent recidivists (violent sample) the mean time to failure was 1320.41 days and those violent offenders that committed a new non-violent offence their mean time to failure was 966.44 days. Overall, these findings suggest that the violent sample recommitted a non-violent offence significantly more-quicker compared to violent offences. For the non-violent sample, the mean time to failure for violent recidivism was 1556.81 days and for non-violent recidivism, the mean time to failure was 772.63 days. Similar to the arson and violent sample for non-violent offences, these findings suggest that the non-violent sample recommitted a non-violent offence significantly more-quicker compared to violent offences.

Next, we used logistic regression (binary) predictions to generate the best fitting predictive models for each recidivism type from each sample. In total, seven prediction models were developed from this type of analysis; three models for the arson cohort, two models for the violent sample and two models for the non-violent sample. The final two predictor variables selected for the arson model (arson cohort) were; first arson < 18-years and number of prior arson offences. These findings suggest that those arson offenders who were young at the time of their criterion arson offence and had more prior arson offences, were significantly more likely to commit additional arson offences in the future. For the violent model (arson cohort) the final three predictor variables were; age at first arson offence, age at first offence < 18-years and number of prior violent offences. Last, the final six predictor variables for the non-violent model (arson cohort) were; age at first arson offence, age at first arson < 18-years, age at first offence < 18-years, number of prior non-violent, prior theft and prior vandalism offences.

Overall, these findings suggest that the age-related predictor variables are commonly featured across all three predictive models and that prior offence history predictor variables are unique and specific to each model within the arson cohort. (i.e., number of prior arsons featured in the arson model; number of prior violent offences included in the violent model and number of prior non-violent offences captured in the non-violent model). Of note, the age-related predictor variable; first arson < 18-years also made inclusion in the Edwards and Grace (2014) study. However, multiple arsons and number of prior vandalism offences included in the Edwards and Grace (2014) model did not make inclusion in arson model this current study. Although one would suggest that multiple arsons and prior arsons are a similar variable with the only difference being the timing of when the previous arsons were committed. For example, were the arson offences committed before the arson criterion

offence date or were all the arsons committed on the criterion offence date (which defines the mass or spree type arsonist).

For the vandalism variable, it is also possible that the raw data collected from the two different NZ government agencies may have been coded or recoded (by the authors) differently given that there is no official offence code for vandalism, therefore we can exclude changes in legal definitions as a factor. Further, how the authors defined vandalism and encoded the raw data from both government agencies may have been a factor. The raw data obtained for the cohort of study 1 relied on official criminal records obtained by the NZ Police and the cohort of study 2 relied on official criminal records obtained by the NZ Ministry of Justice.

The final three predictor variables selected for the violent model (violent sample) were; age at first violent offence, age at first offence < 18-years and number of prior vandalism offences. These findings suggest that violent offenders who were young at the time of their first violent offence, age at their first offence and had more prior vandalism-related offences, were significantly more likely to commit a violent offence in the future. The final four predictor variables selected for the non-violent model (violent sample) were; age at first violent offence, first violent offence < 18-years, number of prior violent and prior non-violent offences. This suggests that violent offenders with these four predictors had a significantly greater rate for non-violent recidivism. Interestingly, the non-violent model included prior violent offences and first violent < 18-years predictor variable and both developed models (violent and non-violent) included the age at first violent offence variable.

Last, the final four predictor variables selected for the violent model (non-violent sample) were; age at first offence, age at first offence < 18-years, number of prior violent and number of prior drug offences. These findings suggest that non-violent offenders with these four predictors had a significantly greater rate for violent recidivism. The final two predictor variables for the non-violent model (non-violent sample) were; age at first offence and age at first offence < 18-years. These findings suggest that non-violent offenders who were young at the time of their first offence and under eighteen years of age had a significantly greater rate for non-violent recidivism. Of note, these two predictive variables in the non-violent model are also included in the violent model (non-violent sample).

For the predictive accuracies of the models, the AUC values for predicting arson, violent and non-violent recidivism (arson cohort) were .61, .66 and .74, respectively. The AUC values predicting violent and non-violent recidivism (violent sample) were .66 and .74, respectively. Last, the AUC values for predicting violent and non-violent recidivism (non-violent sample) were .72 and .75, respectively. These findings suggest that the arson and violent models (arson cohort) and the violent model (violent sample) achieved reasonably average levels of predictive accuracy. All three non-violent models and the violent model (non-violent sample) all achieved reasonably strong levels of predictive accuracy. All the AUC values (arson cohort) were somewhat less than all the AUC values obtained from the Edwards and Grace (2014) study, but more so for the arson model. Thus, the levels of accuracy achieved by this current arson model was slightly lower than the average accuracies reported in Schwalbe's (2008) meta-analysis and is somewhat lower than the original Edwards and Grace (2014) arson predictive model AUC score of 0.68 and substantially lower than the Field (2015) AUC score of .84.

Overall, the findings from the arson predictive model is similar to the Rice and Harris (1996) multivariate prediction equation which relied heavily on the age at first firesetting and past firesetting history. Similarly, these findings (age at first firesetting and a history of firesetting) compliment the Edwards and Grace (2014) study of which these variables provided the strongest contribution for their original arson model. Further, international research suggests that the single best predictor for arson re-offending was previous arson offending (Kennedy et al., 2006; Sapsford et al., 1978) and that young age at first firesetting is a key risk predictor for future firesetting (Rice & Harris, 1991; Edwards & Grace, 2014; Dickens et al., 2009; Doley et al., 2011).

Overall, these conclusions support the international literature on arson recidivism and validates the development of arson risk prediction models (Edwards & Grace, 2014; Ducat et al., 2015; Rice & Harris, 1996). However, not all the findings from this study is entirely consistent with that reported by Rice and Harris (1996). The authors state that variables used to predict arson recidivism are different to the variables used to predict violent and non-violent recidivism. This current study identified that the variables used to predict arson recidivism were somewhat similar with specific violent and non-violent models across the age-related variables. For the arson cohort, age-related predictor variables; first arson < 18-years, age at first arson offence and age at first offence < 18-years were all commonly featured age-related predictor variables across all three predictive models (arson cohort). For the violent sample, the age-related predictor variable; age at first violent offence was a common age-related predictor variable across both the violent and non-violent predictive models (violent sample). Last, for the non-violent sample, age-related predictor variables; age at first offence and age at first offence < 18-years were common age-related predictor variables across both the violent and non-violent predictive models (non-violent sample).

As for prior offence history variables, the number of prior violent offences featured in the violent model (arson cohort), non-violent model (violent sample) and violent model (non-violent sample) but not in the violent model (violent sample). Further, for the number of prior non-violent offences, this featured in the non-violent model (arson cohort) and non-violent model (violent sample) but not in the non-violent model (non-violent sample). Last, for the number of prior vandalism offences, this featured in the non-violent model (arson cohort) and the violent model (violent sample) but not in the arson model as featured in the Edwards and Grace (2014) study. Some of the predictive models, include predictive variables which are consistent with the international arson literature, whilst other models do not include such variables as would be expected. Further, the Cohen's *d* effect size between the various group combinations for the arson cohort and violent sample, arson cohort and non-violent sample and the violent sample and non-violent sample against the age-related and offence history variables did not exceed the Cohen's (1988) convention for small effect size (.20). The findings from this study had small effect sizes and none of the findings produced medium or large effect sizes.

When we investigate the patterns of correlations between arson, violent and non-violent recidivism (arson cohort) we find that the variables; first arson < 18-years and number of prior vandalism offences are featured across all three recidivism types. Although, prior violent, theft, drugs, driving and non-violent offences were only significant variables across the violent and non-violent recidivism types and not for arson recidivism (arson cohort). The findings from the violent sample suggest that the violent and non-violent recidivism types share the same significant demographics and prior offence-history variables (except sexual offence). The significant variables for violent recidivism in the arson cohort and the violent

recidivism (violent sample) were also the same. Also, the significant variables for non-violent recidivism in the arson cohort and non-violent recidivism (violent sample) were the same. Finally, for the non-violent sample, the findings for the violent and non-violent recidivism types both include the same eight significant demographics and offence-history variables. In comparing the arson cohort with the non-violent sample (violent recidivism) both groups had the same statistically significant variables (except drugs and sexual). For non-violent recidivism between both groups (arson cohort and non-violent sample) both had the same statistically significant variables (except drugs). Further, the prior sexual variable was positively correlated in the arson cohort and the violent sample (violent recidivism) but was negatively correlated for the non-violent sample. These findings indicate that certain prior criminal convictions and demographics predict arson, violent and non-violent recidivism at statistical significance levels. Further, some variables are consistently featured across all three recidivism types, more so for violent and non-violent recidivism across all three samples.

The correlations obtained from this study were overall stronger for violent and non-violent recidivism compared to arson recidivism. Overall, these correlations do provide particularly valuable information on whether certain risk factors (age and prior offence history) differ across the three samples in terms of their predictive relationships with arson, violent and non-violent recidivism. Identifying relationships are important preliminary steps for developing and validating actuarial risk prediction models.

Next, we replicated the same 10-point arson risk classification scale from the previously developed Edwards and Grace (2014) scale using the present data. The objective of this test was to determine whether the new arson cohort data would yield the same valid predictions

or if the findings are significantly different between both developed tools. We employed the same methodology and defined four risk bands (low, medium-low, medium-high and high) and relied on the same three final risk predictors (first arson < 18-years, multiple arsons at the criterion date and number of prior vandalism offences) from the Edwards and Grace (2014) study. The percentage of the sample (arson recidivism %) in the four risk bands were; 6%, 10%, 6% and 13% for low, medium-low, medium-high and high, respectively. Further, the proportion of recidivism (% of cases) decreased from; 55%, 16%, 19% and 10% for low, medium-low, medium-high and high, respectively. The predictive accuracy for the current arson cohort was AUC = .60.

Overall, these findings conclude that the predictive accuracy for both studies (current and original) was higher for the original 2014 study compared to the current arson cohort, AUC = .60 vs AUC = .68. Although, some reduction in predictive accuracy would be expected when generalizing to a new sample, the decrease in predictive accuracy may have been due in part to the methodology of both empirical studies and how the index offence was defined in each study. Of comparison, a 9-point arson actuarial model developed by Field (2015) provided an AUC score of .79. This is somewhat higher than the findings indicated by both the Edwards and Grace (2014) study and the current study. Although, Field (2015) used three risk bands instead of the original four by Edwards and Grace (2014) and relied on six risk factors from their predictive model.

Although the current arson cohort does show a reduction in the AUC score by .08 both studies are statistically significant with their AUC scores and both arson cohorts (series one 1985-1994 and series two 1998-2008) had comparative independent mean scores according to the 10-point actuarial scale for predicting arson recidivism. Of interest, the correlation

between the arson model score with arson recidivism suggests that the original Edwards and Grace (2014) study had a stronger (more than doubled) statistically significant correlation compared to the current arson cohort. Nonetheless, replicating the arson actuarial risk prediction model does provide valuable information in supporting of evidence-based approaches for arson recidivism. This current study also confirms that actuarial tools such as this newly proposed tool can be created to predict rare offending events such as arson. Thus, providing operational and practical utility in the clinical, forensic, correctional and judicial settings.

Given that the static risk predictors in the current arson actuarial tool are derived solely from historical predictor variables extracted from a computer database, this tool would be suitable and feasible for automatic scoring purposes (see. Skelton et al., 2006). The availability and feasibility of a simple but effective automatically scored classification instrument will aid the identification of high-risk convicted arson offenders. Any such instrument would provide additional direction and guidance for practitioners (both forensic and clinical), consultants and legal professions in their decision-making processes for assessing and identifying arson recidivists from the wider criminal justice population of arson offenders.

The findings from the LDA test suggest that there is nothing particularly special or unique about a group of arson offenders compared to a group of violent and non-violent offenders with reference to prior offence history variables. Thus, the offence histories for all three offender groups show considerable overlap. In terms of classification, there is relatively little distinction between arson, violent and non-violent offenders. This finding is further supported by the work conducted by Ducat et al., (2015) which identified arson offenders as being highly criminally versatile and less likely to be pure arsonists (having also committed other

types of offences). These findings suggest that arson offenders commit more violent and non-violent crimes than simply arson crimes.

The relatively low rate of recidivism in this study suggests that for most offenders with arson convictions, firesetting is a 'one-off' type of offence which is committed at some point during the course of their criminal careers, but otherwise have no disposition towards. However, even though the overall rates of arson recidivism are relatively low, there still presents a minority of persistent arson offenders (Soothill et al., 2004). Given that arson is a public health and national security issue, any proposed actuarial models for identifying subgroups of arson offenders with elevated risk for arson recidivism is clearly warranted and worthy of additional attention and exploration.

One of the major limitations of the present study, like most second-generation actuarial models was that the arson 10-point classification risk scale was entirely founded on static risk variables such age-related and prior offence histories. Our model similar to the Edwards and Grace (2014) model does not incorporate or consider any criminogenic needs or dynamic risk factors that are strongly associated with arson recidivism. This present study excluded all criminogenic needs and dynamic risk factors which are commonly featured in third-generation risk assessments such as; the Violence Risk Scale (VRS; Wong & Gordon, 2006) and the HCR-20 (v.3) by Douglas et al., (2013). Thus, our present arson actuarial tool is unable to provide any valuable information to support appropriate treatment, intervention management plans or how risk may be mitigated and targeted.

To increase the effectiveness and utility for any arson actuarial risk assessment tool, incorporating both static and dynamic risk factors into a more comprehensive third-

generation approach will advance the risk assessment process for arson recidivism. Best practice guidelines for risk assessment promotes the use of both static and dynamic risk factors in risk assessments. Current literature supports that the risk factors used to inform risk-based assessments should be evidence-based and specific to the target behaviours of the individual, unfortunately there are no such risk assessments for firesetters (Wyatt, 2018). Therefore, the practical importance of third-generation arson recidivism models would allow criminal justice practitioners and practitioners to move beyond simple underlying static risk factors but include factors such as; progress over time in custody, treatment and during supervision orders (Field, 2015).

The arson predictive model and 10-point actuarial tool developed from this study may offer inclusion and collaboration with other promising firesetting risk assessment tools such as the; Northgate Firesetter Risk Assessment (NFRA; Taylor & Thorne, 2012), the St Andrew's Fire and Risk Instrument (SAFARI; Long et al., 2014), the Firesetting Risk Assessment Tool for Youth (FRAT-Y; Stadolnik, 2010), the Pathological Fire-Setters Interview (PFSI; Taylor, Thorne & Salvkin, 2004) and recently developed screening tools such as; the Behavioural Risk Tool (BRT; Dadswell, 2018). To date, there are no-operationally validated and developed Structured Professional Judgement (SPJ) tools to assist practitioners and clinicians for arson recidivism. Although, Doley et al., (2011) suggest that work is underway and such a tool is in its early stages of development and validation. However, there have been no such developments or proposed SPJ tools by any authors to date. Although, the findings from the developed arson predictive models and arson actuarial tools from both empirical studies in this thesis may aid and support the development of future SPJ tools for arson recidivists.

In summary, we addressed the four aims of this chapter by replicating the previously published work by Edwards and Grace (2014). We developed additional empirical based

predictive models for arson, violent and non-violent recidivism among NZ convicted arson, violent and non-violent offenders. We followed arson, violent and non-violent recidivism over a 5-year follow up and identified recidivism rates and survival time (in days) for each sample and each recidivism type. We identified and compared final static risk predictors associated with arson, violent and non-violent recidivism. Next, we replicated and developed a preliminary second-generation actuarial risk-classification tool for identifying high-risk individuals for arson recidivism. Our findings are consistent with the relatively few prior studies on arson recidivism and suggest the feasibility of an automatically scored model to aid the identification of high-risk offenders among the wider criminal justice population of arson offenders. These empirically validated risk assessment tools will assist practitioners and clinicians in providing evidence-based and defensible risk-decisions to assist with case management and treatment plans. Last, we were able to determine based on LDA that we cannot accurately classify or distinguish between a group of arson offenders from a group of violent offenders and non-violent offenders and vice versa.

An important goal for future research will be to extend on the preliminary arson actuarial tool by incorporating criminogenic needs and dynamic risk factors and extend to patient/client medical reports. This will ultimately provide additional scope and direction for future research, practice and guide practitioners (both forensic and clinical), consultants and legal professions in the overall risk assessment and decision-making process for arson recidivists. It is also important when designing second-generation actuarial tools for arson recidivists that the methodology captures the start of the individual's "at-risk" period to reoffend at the time of their criterion date. In doing this, we best capture and reflect the start of the individual's arson criminal careers and not at some point throughout their criminal careers as shown in this study design.

4. CHAPTER FOUR

GENERAL DISCUSSION

The Overarching Goal

"*To develop an actuarial model and risk classification scale to aid the prediction of arson recidivism in a New Zealand context".*

To achieve the overarching goal, we provide the rationale for conducting this type of research, we propose several important aims throughout the thesis and we discuss four key fundamental research questions. The aim of this final chapter is to review and summarise the aims, rationales, key research questions and highlight the operational utility and practical implications of the Edwards and Grace (2014) arson actuarial model.

The Rationale

Prior to the Edwards and Grace (2014) study, there were no empirically developed or validated second-generation actuarial tools for arson recidivism. That is, the authors identified a gap in the risk assessment literature on arson recidivism. To the researchers, knowledge there were no available second-generation actuarial tools for arson recidivism among the wider population of arson offenders in NZ or internationally. Doley et al., (2011) state that there have been no extensive evaluations for arson risk instruments or structured arson risk assessment tools for firesetting recidivism. The authors suggest that this shortcoming is due to limited tools developed to deal with such complex issues. The lack of any such tool in the literature presents serious fundamental, ethical and practice issues for

clinicians, practitioners and officials who are tasked with identifying, managing and treating arson offenders. This creates implications given that professionals are obligated with providing evidence-based risk assessment recommendations in the criminal justice settings. Given that arson actuarial tools are currently lacking in the literature, any attempt to develop such tools will hold great promise for future implications within the clinical, forensic, correctional and judicial settings. The research presented in this thesis holds great promise for researchers in the field to replicate and develop additional arson predictive models and actuarial risk assessment tools for arson recidivism within their respective jurisdictions. Finally, these tools combined with generational approaches to risk assessment will provide valid, justifiable and defensible operational risk assessment tools for the high-end high-risk arson recidivists.

The Thesis

This thesis was presented in four chapters: Chapter one provided a literature review; chapter two proposed a second-generation actuarial tool for arson recidivism (Edwards & Grace, 2014); chapter three replicated the Edwards and Grace (2014) study and chapter four provided a general discussion. Of these, chapter two is founded on original and publishable work, while chapter three contained research which is well-qualified for publication. These two empirical-based studies provided an advanced analysis of two large datasets covering a combined 20-year period, including a total 15-year follow-up and comprising of 5642 NZ convicted offenders.

Summary of the Thesis Aims

To address the overarching goal and rationale for this research we commenced chapter one with one primary aim. This first aim was to provide a background overview and literature review of arson offending in terms of well supported and promising arson risk factors, arson recidivism and arson actuarial risk assessment. We commenced this topic by addressing the arson problem in the US, UK and NZ and we discussed the four generations of risk assessments as defined by Bonta (1996). We discussed the RoC*RoI (Bakker et al., 1999) and its primary use for predicting future general criminal offending within the NZ corrective setting. We discussed third and fourth generation approaches and reviewed several promising firesetting risk assessment tools (such as; the SAFARI, NFRA, PFSI and FRAT-Y). We discussed the importance of the Risk Need Responsivity Model (RNR; Bonta & Andrews, 2007) and its influence on offender risk assessments. We discussed several firesetting theories (such as; the DBToF and M-TTAF) and acknowledged two UK firesetting intervention programmes, the FIPP and FIP-MO.

From here, we explored arson recidivism and arson risk factors drawing on 40-years of research (1978 to 2018). Next, we investigated arson risk assessment and reviewed all developed arson predictive models and arson actuarial tools by four key published researchers who have provided the majority of the evidence in the literature (Rice & Harris, 1996; Edwards & Grace, 2014; Field, 2015; Ducat et al., 2015). Last, we discussed an arson classification table based on the style and type of offending (the serial, mass or spree arsonist). In sum, the literature review and key research findings support the overarching goal and rationale of the thesis and sets the foundation for the two empirical-based studies (chapters 2 and 3) of the thesis.

Following the overview, we progressed to chapter two (comprising of three main aims), the first aim was to extend on the previous work conducted by Rice and Harris (1996) on mentally disordered firesetters. This formed the basis of the research by Edwards and Grace (2014) which investigated convicted and criminally responsible arson offenders. This sample is unique and different from the sample obtained by Rice and Harris (1996) which relied heavily on firesetters from forensic and clinical psychiatric settings. The Edwards and Grace (2014) study includes individuals who make up the wider criminal population of arson offenders in the NZ context. Chapter two was founded on this rationale and formed the complete chapter titled "The development of an actuarial model for arson recidivism" (Edwards & Grace, 2014).

For this aim we developed and validated empirically based predictive models for arson, violent and non-violent recidivism among NZ convicted arson offenders. These three predictive models were based on an arson cohort that were prosecuted through the NZ criminal justice system for an arson-related offence between 1985 and 1994 (n = 1250). Doley et al., (2011) state that while the identification of risk factors for recidivistic firesetting is in its infancy there is considerable scope for further development of a structured risk assessment tool of adult firesetters. The authors do recommend that well-designed, large-scale retrospective and prospective research is required to advance this field (Doley et al., 2011).

Our next aim of this chapter was to identify, compare and discuss the final static risk predictors for arson, violent and non-violent recidivism. We employed a cross validation strategy; whereby the cohort was randomly divided into developmental and validation subsamples (n = 625). The predictive models were estimated based on the developmental

subsample using cox regression. The final predictors generating the arson model were; first arson under 18-years, multiple arsons and having prior vandalism offences. These findings suggest that arsonists who were younger at the time of their criterion offence, had more than one arson charge at their criterion date and had more prior vandalism-related offences were significantly more likely to commit an arson offence in the future. The age-related risk factor is consistent with previous research findings (Ducat et al., 2015; Rice & Harris, 1991; 1996) and with higher number of criminal damage offences (Dickens et al., 2009). Further, Field (2015) identified that young age at first firesetting is a reasonably-well supported risk factor and that multiple arsons and having prior vandalism offences are promising risk factors.

Overall, these findings provide strong empirical support for arson risk prediction development. In comparison, the final predictors for the violent model were; first arson under 18-years, age at first offence, number of prior violent and prior all offences. The final predictors for the non-violent model were; age at first arson, number of prior theft and number of prior drug offences. These findings mirror the results obtained by Rice and Harris (1996) that suggest the variables used to predict arson recidivism are somewhat different to the variables used to predict violent and non-violent recidivism. These differences are not surprising and paints a picture of arsonists as having specific-risk factors for arson recidivism and that these factors are not routinely found in violent or non-violent recidivism.

The empirical evidence presented in this first study suggests that arson recidivists should be regarded as a distinct category of re-offending compared to violent and non-violent recidivists. Based on these findings, it is important to examine risk factors that have been empirically validated to predict future arson recidivism. Given that the variables generated

for the model are derived solely from static variables obtained from computer databases, it would be suitable for automatic scoring purposes (cf. Skelton et al., 2006).

In terms of the predictive accuracy for each predictive model, the arson predictive model provided an AUC score of .70 (developmental subsample) and .68 (validation subsample). These findings indicate that the predictor variables for the arson model are operating at a moderate level of predictive accuracy. It is interesting to note that this level of accuracy is somewhat higher than the average accuracies reported in a meta-analysis conducted by Schwalbe's (2008) study which provided AUC scores of .64 and .65. In comparison, the violent and non-violent predictive models indicate that their predictor variables are operating at a high level of predictive accuracy, AUC scores of .72 and .73, respectively.

The last progressive aim for this chapter was to develop a 10-point risk classification tool using the same three predictor variables generated from the arson predictive model. The scale was developed using the beta weights from the three predictor variables. The defined risk scale varied from 0 to 10. The overall risk score was based on the combined sum of the three predictor variables and the four risk bands were based on the sum of the model scores. As expected, the findings indicate that the percentage of the sample decreased as the risk bands increased from low to high and that the proportion of recidivism increased as the risk bands increased from low to high. The AUC score for the classification tool was .67 which suggests that the predictor variables generating the scale are operating at a moderate level of predictive accuracy.

Interestingly, this AUC score is somewhat higher than other actuarial risk assessment scales such as the STATIC-99 which reported an AUC score of .62 for violent recidivism. It is

proposed that this scale in its present form may provide an accurate risk assessment of groups who have a significant risk for arson recidivism. It is proposed that those groups scoring high on the actuarial scale are significantly more likely to commit an arson offence in the future compared to those who score low on the actuarial scale.

It is important to note that this prediction tool as a stand-alone assessment measure may not be justifiable to make informed decisions and risk assessments. However, in the absence of any such tools it may be justifiable to incorporate these tools in collaboration with other well supported clinical and theoretical approaches (O'Ciardha & Gannon, 2012). Given that this scale is newly developed and in its infancy stages, further testing, refining or enhancement of the actuarial model utilising prospective data is highly recommended prior to any operational use. It provides promise that since the published work by Edwards and Grace (2014) other researchers such as Field (2015) have used similar methodology and developed additional arson predictive models and arson actuarial tools for arson recidivism.

Next, we replicated the Edwards and Grace (2014) study which formed the basis of chapter three. This chapter incorporated four main aims, three of which overlapped the previous aims described in chapter two. The main objective of this chapter was to assess the generalisability and utility of the original Edwards and Grace (2014) actuarial tool. To achieve this task, we present our first aim which was to develop additional empirical based predictive models for arson, violent and non-violent recidivism. These three predictive models were based on a second (non-overlapping) arson cohort who were all prosecuted in NZ for an arson-related offence between 1998 and 2008 (n = 1464). In addition, we obtained a random sample of convicted violent offenders (n = 1464) and a random sample of non-violent offenders (n = 1464).

Our next aim of this chapter was to identify, compare and discuss the final static risk predictors for arson, violent and non-violent recidivism. We employed logistic regression to develop the best fitting models for each recidivism type for each offender group. For each model, the remaining variables in the equation were used to develop the models. The final predictors for the arson predictive model were; first arson under 18-years and prior arson offences. These findings suggest that arsonists who were young at the time of their criterion offence and had more prior arson offences, were significantly more likely to commit an arson offence in the future.

This arson predictive model provided an AUC score of .61 which indicated a low level of predictive accuracy. This score is somewhat lower than the previous Edwards and Grace (2014) study of .68. Nonetheless, these two risk predictors have been identified by Field (2015) as reasonably well supported risk factors. Therefore, the utility of this arson model and its risk factors are not in serious doubt and does provide further support and confidence for the development of empirically based actuarial models for arson recidivism.

In comparison, the final predictors for the violent predictive model (violent sample) were; age at first violent offence, age at first offence under 18-years and prior vandalism offences. This predictive model provided an AUC score of .66, indicating a moderate level of predictive accuracy. Last, the final predictors for the non-violent predictive model (non-violent sample) were; age at first offence and age at first offence under 18-years. This predictive model provided an AUC score of .75, indicating a high level of predictive accuracy.

It is interesting to note that there was only one prior offence history variable used to generate the arson model (prior arsons) and the violent model (prior vandalism) and both offences are

property-related crimes. Further, the vandalism predictor variable made inclusion in the violent predictive model but not in the arson predictive model as featured in the original Edwards and Grace (2014) model. Therefore, it is deemed that vandalism is not a consistent predictor variable in the arson predictive model in chapter three, whereas first arson under 18-years and prior arson offences are consistent and well supported predictor variables. Overall, the final risk predictors in the models developed in chapter three were somewhat different to the predictor variables identified in the Edwards and Grace (2014) study.

Overall, there is no evidence in the literature to identify any cultural-specific reasons or societal changes across the two arson cohort series (1985-1994 and 1998-2008) or to account for the absence or inclusion of the vandalism variable across both empirical studies. Although, it may be possible that the raw data obtained from the various government agencies may have been coded or recorded (by the authors) differently given that there is no official offence code for vandalism in NZ. How the authors defined vandalism and encoded the raw data from both government agencies may have been a factor. The raw data obtained for the first empirical study relied on official records obtained by the NZ Police and the second empirical study relied on official information obtained by the NZ Ministry of Justice. Nonetheless, the vandalism variable has been identified as an important risk factor and does provide much useful information (Edwards & Grace, 2014).

The next aim of this chapter was to develop an additional 10-point risk classification tool using the same three predictor variables from the Edwards and Grace (2014) study and employing the same methodology used in chapter two. Similarly, these findings were consistent with the Edwards and Grace (2014) study in which the percentage of the sample decreased as the risk bands increased from low to high and that the proportion of recidivism

increased as the risk band increased from low to high. The AUC score for the replicated scale was .60. This finding suggests that the scale is operating at a low level of predictive accuracy and is somewhat lower than the previous Edwards and Grace (2014) actuarial scale of .68. Although some reduction in predictive accuracy would be expected when generalizing to a new sample, the decrease in predictive accuracy may be due to the methodology and how the arson index offence was defined. For example, every individual in the first arson cohort, we captured the start of their arson criminal careers. In contrast, individuals in the second arson cohort were investigated at some point during their arson criminal careers and not necessarily at the start of their arson careers. Nonetheless, replicating the 10-point risk classification scale does provide valuable information for future development of empirical-based actuarial tools for arson recidivism.

The final aim of this chapter was to determine whether we can accurately classify and distinguish a group of arson offenders from a group of violent and non-violent offenders. The findings from an LDA test confirmed that we cannot accurately classify or distinguish a group of arson offenders from a group of violent or non-violent offenders. This test suggests that arson offenders in general are not quantitatively different compared to violent and non-violent offenders when relying on prior criminal histories to make such distinctions. However, it must be stressed that these findings were solely based on a test which relied solely on prior criminal histories and no other risk factors or demographics were used. These findings do support current research that arson offenders are more criminally versatile in their general offending and are not pure arsonists (Ducat et al., 2015). Now that we have discussed the overarching goal of this thesis and reviewed the aims and key findings from the first three chapters, we will now address and review the four key foundational and critically important research questions which were investigated throughout this thesis. These key findings support the utility and

justification of the Edwards and Grace (2014) actuarial tool for operational use within the NZ criminal justice system.

The Research Questions

1). Can actuarial tools be created to predict rare offending events such as arson offending?

Arson and firesetting behaviour are deemed to be a serious public health issue, as such there is a need to prevent such issues. Developing arson risk assessment tools which may aid the identification of "at-risk" individuals for arson recidivism will greatly assist with preventative efforts. Given that arson risk assessment tools will impact public health and safety, national security and the liberties of those assessed it is important that valid and reliable actuarial tools are developed. Rice and Harris (1996) state that the development of a risk prediction tool for firesetters is certainly an attainable goal for which their study provides a good starting point (Quinsey et al., 1998; Rice & Harris, 1996). This goal compliments the work by Geller (1992) who reinforced the need for the development of risk prediction tools for firesetters (Rice & Harris, 1996; Quinsey et al., 1998). Further, Doley et al., (2011) state that there have been no extensive evaluations of arson instruments or structured arson risk assessment tools. Edwards and Grace (2014) reviewed these pressing issues and gaps in the arson literature and intuitively developed such advancements in the field of offender risk assessment.

To date, there are the only four published researchers (Rice & Harris, 1996; Edwards & Grace, 2014; Field, 2015; Ducat et al., 2015) that have developed arson predictive tools (this includes; logistic regression equations, multivariate prediction equations and improper models) which have contributed to the risk assessment literature. The work discussed by

these four key authors includes; mentally disordered male firesetters, criminally responsible convicted male and female arson offenders, adult and juvenile offenders, covering five jurisdictions (Canada, NZ, England/Wales and Australia) and extending over 24-years of arson research.

This research question is discussed throughout each chapter and reflects the overarching goal of this thesis which was to develop an actuarial model and risk classification scale to aid the prediction of arson recidivism in a NZ context. The Edwards and Grace (2014) study addressed such scientific development and built second-generation arson predictive models and arson actuarial tools for predicting arson recidivism. From this, the authors provide a simple, user-friendly and automatically scored operationalised risk classification tool for NZ convicted arson offenders. Based on the findings from both empirical studies (chapters 2 and 3) the authors confirmed that actuarial tools including those developed in this thesis can be created to predict rare arson offending events with moderate levels of predictive accuracy (see Edwards & Grace, 2014).

Field (2015) concludes that there is only one developed and empirically validated actuarial prediction model for arson offenders and that is the work conducted in NZ by Edwards and Grace (2014). Field (2015) used the same methodology employed by Edwards and Grace (2014) and developed additional arson predictive models and arson actuarial tools for arson recidivism in the UK context. To date, Edwards and Grace (2014) and Field (2015) are the only two published researchers who have developed evidence-based actuarial tools for predicting arson recidivism in the wider population of convicted arson offenders in NZ and the UK.

The review conducted by Field (2015) adds to the credibility and validity of the Edwards and Grace (2014) study and complementing its high quality:

"*The aims of the study were clear and the sample inclusive and comprehensive, allowing some confidence in its wider applicability. The length and completeness of the follow-up and attempt to equalise "at-risk" periods add to the strength of this study, and the statistical methods used, and clarity of reporting are also a strength*" (Field, 2015).

Last, we discussed the current use of the RoC*RoI as a standard measure for conducting risk assessments for all types of NZ convicted offenders held in custody. This second-generation actuarial tool is used to assess and predict arson reoffending. The RoC*RoI further supports this research question that actuarial tools can be created to predict arson offending. To date, the RoC*RoI is the only preferred and current measure of choice for convicted arson offenders in NZ. No other second-generation arson actuarial tools have been implemented for operational use by the NZ Department of Corrections. Such a tool designed specifically for arson offenders (Edwards & Grace, 2014) would enhance the validity and reliability of risk assessment tools for such a specific and rare type of offender within the NZ corrective setting.

2). Are individuals who commit arson qualitatively different from individuals with non-arson criminal histories?

This research question is discussed throughout each chapter and supports one of the primary goals of this thesis which was to develop predictive models for arson recidivism and compare them with violent and non-violent predictive models. The final predictors used to generate the

Edwards and Grace (2014) arson predictive model were; first arson under 18-years, multiple arsons and having prior vandalism offences. In comparison, the final predictors for the violent model were; first arson under 18-years, age at first offence, number of prior violent and number of prior all offences. Last, the final predictors for the non-violent model were; age at first arson, number of prior theft and number of prior drug offences (Edwards & Grace, 2014). These comparisons determined that the final risk predictors used to generate the arson predictive model were somewhat different to the final risk predictors used to generate the violent and non-violent predictive models (Edwards & Grace, 2014).

These findings support the results obtained by Rice and Harris (1996) that suggest the variables used to predict firesetting recidivism are quite different to the variables used to predict violent and non-violent recidivism. This finding was supported by a multiple discriminant function in which firesetting shared 3% common variance with violent recidivism but 34% common variance with non-violent recidivism (Rice & Harris, 1996). Further, Rice and Harris (1991) identified that arson offenders are more likely to have lower levels of violence and aggression compared to violent offenders who display higher levels.

Overall, these findings indicate that the act of firesetting is unique and different from violent and non-violent crimes but more so for violent crimes (Rice & Harris, 1996; Quinsey et al., 1998). This suggests that arson should be viewed as a unique category of offending which is distinct and separate from other types of offending such as violent and non-violent crimes (Field, 2015). Thus, firesetting behaviourally manifests differently to other offences. It is this reason that more focus should be directed on investigating the factors that specifically predict arson recidivism rather than examining the wider definitions of recidivism (Field, 2015).

In contrast, an LDA test (chapter 3) which relied on prior criminal histories could not clearly distinguish or classify a group of arson offenders from a group of violent or non-violent offenders. We identified that there was considerable overlapping of prior criminal convictions among the three different groups of offenders (arson, violent and non-violent). Further, the work conducted by Virkkunen et al., (1996) investigated psychiatric and biochemical variables between firesetters and violent offenders in Finland. The authors were unable to clearly distinguish between arson offenders and violent offenders in terms of recidivism and index offences. These findings suggest that arson in general is not a separate category of offending and is not clearly distinguishable from other types of crimes.

In addition, the work by Ducat et al., (2015) suggests that arson offenders tend to be more criminally versatile and have other prior criminal convictions (other than arsons) and are less likely to be pure arsonists (having committed other types of offences). The authors suggest that when assessing the risk of firesetting recidivism, clinicians should consider fire-specific history, general criminality, and the impact of mental disorders on recidivism (Ducat et al., 2015). This complements the review conducted by Gannon and Pina (2010) that indicate adult firesetters are generally more criminally versatile and are aligned to property offenders than violent offenders. Also, serial arsonists have a history of committing other crimes which are predominantly property-related offences (Doley, 2009, Barnett & Spitzer, 1994; Hurley & Monahan, 1969).

Last, the review by Dickens et al., (2009) suggests that repeat firesetters in England were significantly more likely to have prior property-related convictions, spent more time in prison and were younger at their first conviction. This evidence points to extensive criminal histories as a key predictor for firesetting recidivism (Rice & Harris, 1991; Ducat et al., 2015).

3). To what degree should individuals who commit arson be assessed, managed and treated uniquely in the criminal justice system?

This research question was primarily discussed in chapters 1 and 4. The expectation is that the actuarial tools developed by Edwards and Grace (2014) will support practitioners, clinicians and like-minded professionals in identifying high-risk arson offenders who have the proclivity and propensity for arson recidivism. The work presented in this thesis will aid the decision-making and senior management processes for appropriate risk assessment, supervision and security classification of high-risk arson offenders in the corrective setting. It is stressed that the Edwards and Grace (2014) actuarial model is built on a second-generation approach which relies heavily on static risk factors and no criminogenic needs or dynamic risk factors were included. Its primary use was to conduct a preliminary risk assessment to provide a long-term view of future risk for high-risk arson offenders within the criminal justice system. Further, the Edwards and Grace (2014) tool is a specialist tool which identifies those who are most at-risk for future firesetting. This supports practitioners overseeing interventions (FIPP and FIP-MO) and can identify those in most need for therapy or treatment against those requiring minimal treatment reducing unnecessary associated resources and public expenses.

Gannon et al., (2012) and Tyler et al., (2018) developed the UK-based FIPP and FIP-MO programmes which are both empirically informed specialist treatment programmes for firesetters. Both these programmes are under pinned by the M-TTAF theory and address the key psychological factors and criminogenic needs associated with firesetting behaviour. Gannon et al., (2012) recommends that firesetters should be treated uniquely by using

specialist firesetting intervention programmes rather than general offending behaviour programmes.

Although, Doley et al., (2009) suggests that firesetters rarely only engage in arson-related offences and emphases that risk factors and criminogenic needs relevant to general offending are important. The authors state that the pattern of prior criminal offending and antisocial behaviour appear to be important contributors when evaluating the overall risk of arson recidivism (Doley, 2009).

4). How can arson actuarial tools be used and who would benefit from using them?

This research question was primarily discussed in chapters 1 and 4. It is proposed that second-generation actuarial tools developed by Edwards and Grace (2014) will be of practical and operational use for the NZ criminal justice system and provide implications internationally. Any attempt to assess and identify high-risk individuals who have the proclivity and propensity for committing such highly destructive and recidivist behaviour in the community is highly warranted and worthy of additional attention and exploration.

Similar to the RoC*RoI tool, the Edwards and Grace (2014) actuarial tool may provide scientific empirical evidence to support offender management decisions for classification, supervision and guide clinical decision-making for appropriate treatment and rehabilitation. It is proposed that the Edwards and Grace (2014) model would be of considerable benefit for the NZ Department of Corrections if merged with IOMS or the RoC*RoI model. The Edwards and Grace (2014) tool if combined with the RoC*RoI may strengthen the predictive accuracy in identifying high-risk groups who have the proclivity and propensity for

committing arson offences in the future. In collaborating our efforts, we promote transparency, strengthen firm defensible and justified recommendations, and support ethical and legal issues (upholding the rights and liberties of those convicted of arson). Finally, these actuarial tools may be factored in with firesetting theories such as the M-TTAF. By this, the Edwards and Grace (2014) tool may extend on the static risk factors included in the tier one developmental context of the M-TTAF theory. We will discuss how the Edwards and Grace (2014) actuarial tool can be operationalized and used in practice to benefit multiple sectors of the criminal justice system, such as; judicial, treatment, custodial, parole and investigations.

CRIMINAL JUSTICE SYSTEM

Judicial

The Edwards and Grace (2014) actuarial tool may provide evidence in District and Supreme Court trials for sentencing, court disposal decisions and discretionary release applications. As noted, professionals within the CJS are relied upon to make risk informed sentencing and court disposal decisions based on an individual's level of dangerousness (Cooke & Mitchie, 2013). In addition, the Edwards and Grace (2014) actuarial tool may support bail considerations, such as; refusing bail or recommending appropriate bail conditions (electronic monitoring such as GPS ankle bracelets) during the bush fire season. The authors do stress the importance of accurate, valid and defensible evidence-based risk assessment tools to support the judicial system.

Treatment

The Edwards and Grace (2014) actuarial tool may provide additional support and inclusion with third and fourth generation approaches (SAFARI, NFRA, PFSI and FRAT-Y). The authors do stress that second-generation tools in isolation do not offer any specific clinical guidance for treatment that are primarily based on criminogenic needs and dynamic risk factors. However, the operational utility of the actuarial tools in collaboration with promising firesetter instruments or treatment programmes (FIPP and FIP-MO) may aid clinicians and practitioners in identifying "high-risk" individuals who are most suitable for treatment, intervention and rehabilitation programs. In essence, the actuarial tool is best suitable for screening and identifying "high-risk" cases requiring extensive treatment against those "low-risk" cases not requiring extensive resources or complex treatment.

This is similar to the work conducted by Dadswell (2018) who developed a preliminary screening measure, the Behaviour Risk Tool (BRT). The screening tool is the first such tool developed in the Australian context and was designed to identify cases where additional mental health intervention and support may be necessary (Dadswell, 2018). Overall, the research proposed in this thesis allows the assessment process to take another step towards evidence-based clinical practice.

Custodial

The Edwards and Grace (2014) actuarial tool may assist the NZ Department of Corrections with offender management decisions which includes; classification, supervision and treatment allocation of high-risk arson offenders. The arson actuarial tool may complement and support other existing generalist second-generation actuarial tools (RoC*RoI; Bakker et

al., 1999) currently used by the NZ Department of Corrections. The Edwards and Grace (2014) actuarial tool may assist with determining involuntary detention to reduce the risk of future harm caused by firesetting (Watt & Ong, 2016).

Parole

Second-generation actuarial tools such as the Edwards and Grace (2014) tool may support firm defensible, transparent and valid recommendations to tribunals, national parole boards and prison boards for arson parolees. Any recommendations based on the Edwards and Grace (2014) tool may support parole conditions such as; intensive monitoring (GPS ankle bracelets), stricter supervision, stricter parole and reporting conditions for the arson parolee. Therefore, risk assessments may be utilised for the decision-making processes for potential release from prison (Watt & Ong, 2016).

Investigations

Operationalised actuarial tools such as the Edwards and Grace (2014) tool may guide and provide consultation and subject matter expertise to local investigators and analysts for prioritising and rank-ordering suspects in historical and unsolved arson cases. The Edwards and Grace (2014) arson actuarial tool may support other firesetter screening initiatives such as; the Bushfire Arson Target Screening (BATS; Bennett et al., 2010). Identifying risk factors for arson recidivists may also support and aid psychological profiling (Edwards & Grace, 2006; Edwards, 2004) and the circle theory of environmental range proposed by Canter and Larkin (1993). The two risk factors (arsons and vandalism offences) in the arson predictive model may be used to best reflect and extend the scope the criminal range of an arsonist. The actuarial risk assessment tool may assist with bail applications and conditions

from a police station (refusing bail, memorandums to Prosecutors, strict bail conditions). The Edwards and Grace (2014) tool may guide subject matter expertise in parliamentary inquiries and Royal Commissions relating to significant bushfires and critical incidents involving bombings and explosives.

Overall, the research conducted in this thesis impacts public health and safety, national security, the criminal justice system and the rights and liberties of those convicted of arson. The work presented by Edwards and Grace (2014) promotes transparency, aid second, third and fourth generation approaches and provides guidance in identifying and managing high-end high-risk individuals who have the propensity and proclivity for committing further arson offences in the community. Our proposed operational actuarial tool may play a key role in the decision- making process to support various government agencies, departments, key service providers and stakeholders.

IMPLICATIONS

The two empirical-based studies in this thesis (chapters 2 and 3) focussed exclusively on static risk factors to develop the arson actuarial tools. Unfortunately, both studies did not investigate or incorporate any criminogenic needs or dynamic risk predictors as adopted in third and fourth-generation risk instruments. Further, this thesis did not have the capacity to explicitly incorporate, validate or test any firesetter theories (M-TTAF or DBToF) or treatment approaches (FIPP or FIP-MO) or firesetting perspectives (FOC-MD or DMAF) with the developed actuarial tools. Last, the two empirical studies in this thesis did not explore arson motivational variables, psychiatric variables, emotional variables, cognitive, affective or behavioural processes or the modius operandi (MO) of the arson offender. This

type of information may play an important role in further understanding the risk of recidivism and may refine proposed actuarial models (Field, 2018). These factors may also act as treatment needs for targeted intervention allowing for behaviour change in a way that second-generation actuarial tools are unable to do.

As discussed, any developed or promising actuarial tools must incorporate both static and dynamic risk factors drawing on actuarial and clinical approaches to offender risk assessment (RNR; Bonta & Andrews, 2007). The findings from both empirical studies in this thesis strongly support the need to consider multiple risk factors when assessing the overall risk of firesetters (Gannon et al., 2012; 2013). Overall, this thesis focussed primarily on identifying well supported and promising static risk predictors to develop second-generation approaches to aid third and fourth-generation risk assessments.

One of the most widely used SPJ instruments for assessing violent risk is the HCR-20 (Douglas et al., 2013). The authors suggest that the HCR-20 has been identified as a useful tool for assessing the risk of arson recidivism for those firesetting behaviours that are deemed violent (Gannon & Pina, 2010). However, based on the Edwards and Grace (2014) study, there is a lack of evidence to suggest that both arson and violent offenders have the same or similar underlying static risk factors associated with recidivistic offending. The evidence presented in this thesis is that the variables associated with arson recidivism are somewhat different to the variables associated with violent and non-violent recidivism. Consistent with previous research, prior offence histories for the arson recidivism are more aligned to arson offences that are more specific to the arson offender with no clear links with violent crimes.

To date, there are no fully established, tested or validated SPJ tools for arson recidivism in adults and only several validated actuarial tools have been developed so far (see Edwards & Grace, 2014; Field, 2015). Although, Doley et al. (2011) suggests that work is underway and such a tool is in its early stages of development and validation. The major difference between promising firesetter tools (SAFARI, NFRA, PFSI and FRAT-Y) and the Edwards and Grace (2014) actuarial tool is that the earlier are not pure actuarial or second-generation in nature but rather a combination of both static and dynamic risk predictors with clinical oversight. Although, the work presented in this thesis did not develop a fully established SPJ tool, the authors did develop an actuarial tool that accurately identifies groups at greater risk for arson recidivism. The availability of a simple, user friendly and automatically scored classification instrument would be of great value if consolidated and incorporated into any further SPJ tools.

In chapter one, we discussed the importance of the RoC*RoI as an actuarial tool in NZ and we reviewed any relationships and differences with the Edwards and Grace (2014) tool. We reported that both the Edwards and Grace (2014) tool and the RoC*RoI tool are second-generation actuarial tools that are primarily based on static risk factors and not criminogenic needs or dynamic risk factors. The RoC*RoI tool is designed on two statistical risk models, the Risk of re-Conviction and Risk of re-Imprisonment (Bakker et al., 1999). Whereas the Edwards and Grace (2014) tool is a stand-alone statistical model to predict the risk of arson recidivism and was not designed to predict the risk of imprisonment or the seriousness of arson offending.

The RoC*RoI weighs on 16 static risk factors to generate the model, whereas the Edwards and Grace (2014) model relies on three static risk factors to generate the arson predictive

model. The predictive accuracy of the RoC*RoI provided an AUC score of .76 which indicates a high level of predictive accuracy (Bakker et al., 1999) compared to the Edwards and Grace (2014) actuarial model which provided an AUC score of .68. The RoC*RoI model provides a more accurate model for risk assessment of general offenders compared to the Edwards and Grace (2014) model. Both tools rely on risk scores to identify "high-risk" and "low-risk" offenders. Those deemed "high-risk" would receive more intensive treatment and rehabilitation compared to "low-risk" offenders who would receive less complex and extensive treatment. The main difference between both tools is their study design and what the models were intended to assess and achieve. That is, the RoC*RoI was designed to predicts future general criminal offending, whereas the Edwards and Grace (2014) model was designed to predict a specialist form of offending (specifically arson and firesetting). The need for a specialist tool would greatly enhance the validity, reliability and justification of risk assessment tools in the NZ context.

FUTURE DIRECTIONS AND LIMITATIONS

A limitation of the two arson cohort studies is that they stem from several decades ago, the first arson cohort series (1985 to 1994) and the second arson cohort series (1998 to 2008). As things change over time, so do societal changes, the findings from both studies in this thesis do not inform us whether arson risk predictors are stable or static over the decades. Further, we are unable to determine whether the arson predictive model will continue to accurately predict arson recidivism in the future. Therefore, incorporating prospective data in this thesis would have supported and strengthened the credibility, generalisability and utility of the proposed arson actuarial tools. However, the findings from the two arson cohorts do come

with extensive follow-up periods (10-years and 5-years) which does provide particularly valuable data on recidivism.

The two arson cohorts primary focused on individuals who were judged to be criminally responsible for their arson offences at the time of their prosecutions. Both empirical studies did not identify any cases which were found not guilty by "reason of insanity, acquitted insane or diminished responsibility". Thus, the two arson cohorts comprised of all convicted arson offenders in NZ over a combined twenty-year period and were processed by the NZ criminal justice system and not a forensic, psychiatric or clinical setting. Thus, the two arson cohorts under investigation cannot be said to representative of all arsonists in the many diverse and specific settings, environments and jurisdictions. Therefore, caution must be exercised when extrapolating findings from the wider criminal justice population of arson offenders to forensic, clinical or psychiatric populations. Although, it is expressed that criminal justice samples are likely to be more representative of the general population of arsonists compared to those studies carried out in forensic settings (Field, 2015). This current research does provide a useful counterbalance towards exclusive psychiatric and forensic samples found in many of the other studies in the arson literature.

The issue of low arson detection and conviction rates was discussed earlier in the thesis which does place limitations on arson recidivism research. That is, the two arson cohorts did not include those individuals who commit arsons and go through undetected, unapprehended or un-noticed by the local authorities, but rather cases that have attracted the attention of the judicial system. In addition, the two arson cohorts did not include arsonists who were not charged due to insufficient evidence, plea deals or were subsequently discharged without conviction, not proven or other. This does limit the overall scope of the arson problem given

that we may only investigate a fraction of the true arson problem. While there is no simple solution to this issue, caution must be exercised when extrapolating the findings from a select cohort to the wider population of arsonists and firesetters who avoid detection and contact with the criminal justice system. It is also important to acknowledge that this type of research only assists with identifying factors associated with further detected arson and firesetting recidivism and does not capture all instances of arson and firesetting behaviour.

Missing data was evident in the NZ Ministry of Justice dataset which was a weakness in the second arson cohort series (chapter 3). That is, this dataset excluded most of the court hearing dates which represented the criterion hearing dates for each participant. Unfortunately, the authors had to make necessary adjustments to define a new criterion date for the second study. For example, the first arson cohort took the commencement of their follow-up period at the time of their first arson court hearing date (after their first arson offence). This provided an accurate follow-up period and the start of their arson criminal careers. Whereas, the second arson cohort series, took the follow-up period at some point in time during the defined year selected by the NZ Ministry of Justice. With this varied type of methodology, the second arson cohort likely captured the criminal careers of the arsonist at varying points of their lives and not necessarily at the commencement of their arson criminal careers. Although, this limitation would have been of greater concern had the authors not obtained a large representative sample size (n = 1464) and year selected (1998 to 2008) to help guide the new criterion dates. Overall, the first arson cohort series provided a 10-year follow-up period which commenced at their criterion hearing date vs the second arson cohort series providing a 5-year follow-up period commencing sometime near the year selected as their index offence.

The data obtained by the NZ Police for the first arson cohort study identified that all but four participants were males. However, the data obtained by the NZ Ministry of Justice for the second arson cohort identified 199 participants were females. In support of this, the gender table obtained from the NZ Ministry of Justice indicated that during the same period (1998 to 2005) there were 164 female convicted arsonists. Therefore, the gender data provided for the first arson cohort was not particularly reliable, and no further analysis was conducted against that gender demographic variable. All other variables used throughout both empirical studies appear reliable and consistent and no other ambiguities were identified in this research. Although, for the second arson cohort (chapter 3) whilst some results can be generalised to the wider population of convicted male arsonists, caution must be exercised when extrapolating the same findings to the wider population of convicted female arsonists.

Another limitation of the Edwards and Grace (2014) tool, like all second-generation actuarial tools was that it is based entirely on static variables such as offence history and demographics. The Edwards and Grace (2014) tool does not incorporate any criminogenic needs or dynamic risk factors that are associated with arson recidivism and are included in third-generation risk assessments such as the Violence Risk Scale (VRS; Wong & Gordon, 2006). Therefore, the Edwards and Grace (2014) tool is unable to provide any direct recommendations for appropriate treatment targets, criminogenic needs or how risk can and should be mitigated. Further, both empirical studies did not incorporate any detailed diagnostic, childhood, motivations or family dynamics that can be readily obtained from psychiatric reports and clinical files. To increase the overall accuracy, utility and feasibility of arson risk assessments the next phase is to incorporate both static and dynamic risk variables into a more comprehensive third-generation tool for offender risk assessment.

Further refinement of the original Edwards and Grace (2014) 10-point risk classification scale is discussed by other authors and must be acknowledged. As noted by Bennett and Davis (2016) the risk bands and proportion of recidivists in the Edwards and Grace (2014) actuarial tool is slightly misleading. By that, the recidivism rates for each of the four risk bands in the Edwards and Grace (2014) study were 3% (low), 8% (medium-low), 11% (medium-high) and 22% (high). In actuarial risk assessment, a medium risk band is the level of risk by the average offender (Bennett & Davis, 2016) in this case the medium risk band should reflect the base rate of 6.2%. The medium-low risk band in the Edwards and Grace (2014) study is 8%. The low-risk band would include the group that reoffends at least half of the medium risk band (Monahan et al., 2001) which would be 3.1%. The high-risk band would indicate the group reoffends at least twice the rate of the medium risk band, which would be 12.4%. Bennett and Davis (2016) conclude that this is an easily rectified consideration but overall states that the Edwards and Grace (2014) tool is a promising instrument for assessing the risk of arson recidivism.

On this note, possible refinement of the tool would include designing three risk bands as opposed to the current four used by Edwards and Grace (2014). The actuarial risk tools developed by Field (2015) used three risk bands (low, medium and high) as opposed to four risk bands (low, low-medium, medium-high and high). The scores for the risk tool in the Field (2015) study ranged from 0 to 9 (whole sample) and 0 to 6 (female-only) whereas the Edwards and Grace (2014) scores ranged from 0 to 10.

Last, it is stressed that the Edwards and Grace (2014) actuarial tool was built on NZ data and is therefore only relevant and limited for use within the NZ context. It is too early to determine whether this tool is applicable to other jurisdictions unless the models are

replicated in other jurisdictions. It would be important to assess the generalisability and utility of the tool across other jurisdictions (outside NZ and the UK) such Australia. Fortunately, we have obtained an arson cohort (2004-2018) from the Western Australian Police Force (*n* = 1038). This next piece of empirical research will replicate the work conducted by Edwards and Grace (2014). So far, the findings from this thesis are only relevant for use in the NZ setting.

Overall, future research should seek to address the limitations discussed in this chapter and at the same time retest and refine developing and promising actuarial risk assessment tools for operational use in the clinical, forensic and criminal justice setting.

CONCLUSIONS

This thesis addressed the overarching goal which was to develop an actuarial model and risk classification scale to aid the prediction of arson recidivism in a New Zealand context. We developed an arson predictive model and a novel second-generation actuarial risk assessment tool for arson recidivism using a large NZ sample (*n* = 1250) of official conviction data between 1985 and 1994 (Edwards & Grace, 2014). The final predictors generating the arson predictive model were; first arson under 18-years, multiple arsons and having prior vandalism offences. These findings suggest that arsonists who were younger at the time of their criterion offence, had more than one arson charge at their criterion date and had more prior vandalism-related offences were significantly more likely to commit an arson offence in the future. Field (2015) identified that young age at first firesetting is a reasonably-well supported risk factor and that multiple arsons and having prior vandalism offences are promising risk factors.

These findings do provide strong empirical evidence to support and validate the development of arson risk prediction models. Next, we developed a 10-point risk classification scale using the same three predictor variables from the arson predictive model. It is proposed that the actuarial risk tools developed in this thesis may hold great promise in identifying at-risk groups who have significantly greater risk for arson recidivism. It is concluded from the tools developed, that as a group, those arsonists scoring high on the actuarial risk scale are significantly more likely to commit additional arson offences in the future compared to arsonists with lower risk scores. The developed tools combined with established SPJ and case formulation approaches may guide clinical decision-making (intensity and progress of treatment) and also assist criminal justice practitioners with supervision orders and discretionary release applications.

Next, we assessed the generalisability and utility of this newly developed tool by replicating the Edwards and Grace (2014) model. We developed additional arson predictive models and arson actuarial tools using a second large size non-overlapping arson cohort (n = 1464) between 1998 and 2008. The final predictors used to generate this arson model were; first arson under 18-years and prior arson offences. These findings indicate arsonists who were young at the time of their criterion offence and had more prior arson offences, were significantly more likely to commit an arson offence in the future. These two risk predictors have been identified by Field (2015) as reasonably well supported risk factors and provides additional support for the development of empirically based actuarial models for arson recidivism. Overall, these findings aid the prediction of arson recidivism and also narrow the scope for future research in this field.

It is concluded from this work that we can develop simple, user-friendly and automatically scored operationalised 10-point risk classification tools to accurately assess, identify and manage high-risk arson offenders in the NZ context. Given that the risk predictors generated from the actuarial models are derived solely from static risk variables obtained from government computer databases, it would be suitable for automatic scoring purposes (Skelton et al., 2006).

As part of the overarching goal of this thesis, we addressed several important and overlapping aims throughout, we support the rationales for conducting such important research and we addressed four critically important and fundamental research questions. Based on the empirical evidence presented from the Edwards and Grace (2014) study we confirm with strong confidence that actuarial tools can be created to predict rare offending events such as arson offending. To date, there are the only two published researchers (Edwards & Grace, 2014; Field, 2015) who have developed and validated evidence-based actuarial tools for arson recidivism among their respective jurisdictions (NZ and UK).

Second, we can confirm with confidence that individuals who commit arson are qualitatively different from individuals with non-arson criminal histories. It was identified that the variables used to predict arson recidivism are somewhat different to the variables used to predict violent and non-violent recidivism (Rice & Harris, 1996; Edwards & Grace, 2014; Field, 2015). This suggests that arson should be viewed as a unique category of offending that is both distinct and separate from other types of offending such as violent and non-violent crimes (Field, 2015). Further, the work by Ducat et al., (2015) suggests that arson offenders tend to be more criminally versatile and have other prior criminal convictions (other than arsons) and are less likely to be pure arsonists (also committing other types of

offences). These findings support the review conducted by Gannon and Pina (2010) in which adult firesetters are generally more criminally versatile and are more aligned to property offenders than violent offenders.

Third, we support that individuals who commit arsons should be assessed, managed and treated differently in the criminal justice system. It is proposed that the Edwards and Grace (2014) actuarial tool may be combined with promising and developing third and fourth generation approaches (SAFARI, NFRA, PFSI and FRAT-Y). This complements the work by Gannon et al., (2012) that recommends firesetters treated uniquely using specialist firesetting intervention programmes (such as the FIPP and FIP-MO) rather than general offending behavioural-based programmes. Further, the Edwards and Grace (2014) arson actuarial tool may complement other generalist second-generation actuarial tools such as the RoC*RoI (Bakker et al., 1999). This work identifies high-risk groups of individuals who have the proclivity and propensity for committing future arsons. A goal of this research is to assist in guiding appropriate case management for treatment allocation, intensity, intervention and rehabilitative programmes for clinicians and practitioners to manage and reduce the likelihood of arson recidivism.

Last, we discuss how arson actuarial tools may be used and who would benefit from using them. The Edwards and Grace (2014) actuarial tool may be operationalised to provide accurate, valid and justifiable evidence-based risk assessments to aid multiple sectors of the criminal justice system, such as; judicial, treatment, custodial, parole and investigations. Overall, the scientific work presented in this thesis, impacts public health and safety, national security, the criminal justice system and the rights and liberties of those convicted of arson. In this thesis, we present an original second-generation actuarial tool for convicted arson

offenders in NZ (Edwards & Grace, 2014). In doing this we support Bonta's (1996) generation approach to risk assessment, we support firesetter theories and influential models (RNR), we help promote future research in the field of offender risk assessment to assist clinicians, practitioners and like-minded professionals in identifying high-risk individuals who have the proclivity and propensity for committing additional arson offences in the future.

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APPENDICES

APPENDIX A

NZ Ministry of Justice Official Information Request

MINISTRY OF JUSTICE
Tāhū o te Ture

Justice Centre | 19 Aitken Street
DX SX10088 | Wellington
T: 04 918 8800 | F: 04 918 8820
E: contactus@justice.govt.nz | W: www.justice.govt.nz

1 0 DEC 2019

Michael Edwards
Michael.edwards@pg.canterbury.ac.nz

Dear Mr Edwards

Official Information Act 1982 request

Thank you for your Official Information Act 1982 request of 18 November 2019 regarding information about arson. On 25 November 2019, the Ministry of Justice (the Ministry) sought clarification of your request. You agreed to receive the following:

1. *People convicted of an arson related event (if an offender has multiple arson convictions, the offender is counted in the year of their first conviction only).*
2. *People charged per year by outcome (counting people once per year).*
3. *People convicted per year (counting people once per year) broken down by gender, ethnicity and age.*

In response to your requests, please refer to Tables 1, 2, 3a, 3b, 3c attached. You provided the Ministry with a list of arson related offence codes. The Ministry used the same offence codes to obtain the data. Please refer to Appendix A attached for the list of arson related offences.

If you are not satisfied with this response, you have the right to complain to the Ombudsman under section 28(3) of the OIA. You can contact the Office of the Ombudsman by writing to PO Box 10152, Wellington 6143; calling 0800 802 602; or emailing info@ombudsman.parliament.nz

Yours sincerely

Jacquelyn Shannon
Group Manager, Courts and Tribunals, Regional Service Delivery

Ref: 79477

Encl:

- Appendix A: List of offence codes for arson related offences
- Tables 1 to 3c

List of Offence Codes for Arson Related Offences

Appendix A: List of offence codes for arson related offences

Offence Code	Offence Description
5110	Arson
5111	Wilfully Damage Property By Explosive/Endanger Life
5112	Wilfully Sets Fire To Property/Endangers Life By
5113	Attempted Arson
5114	Damage Special Property (Not Interest)
5115	Damage To Property Etc (No Interest)
5116	Damage To Property- Reckless
5119	Other Arson

Table 1 (Question 1): Number of people convicted of an arson related offence, by calendar year of their first conviction, from 1985 to 2018

Year of first conviction	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Number of people	126	157	136	127	147	104	109	122	118	136	131	137	145	188	132	126	150	127	149	149	150	150	153	197	180	177	125	139	151	111	123	101	87	113

Notes:

- This data consists of the number of people convicted of at least one arson related charge since 1985.
- If a person is convicted of multiple arson related charges, they are counted by the calendar year of their first convicted charge after 1985.

Table 2 (Question 2): Number of people charged for an arson related offence, by charge outcome and calendar year, from 1985 to 2018

Outcome	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Convicted	126	159	138	134	152	117	114	127	132	148	142	143	154	200	147	138	164	136	159	164	167	156	167	212	194	187	132	149	170	126	135	111	95	117
Other proved	19	40	27	24	29	10	15	13	32	31	30	35	33	31	31	56	37	34	56	63	86	71	67	65	51	54	55	52	41	40	38	42	34	24
Not proved	43	41	35	58	59	57	56	49	72	89	86	84	98	100	91	105	101	96	96	115	118	143	139	132	137	108	80	84	89	52	43	45	28	26
Other	3	1	1	5	9	4	5	0	5	2	6	6	5	7	3	3	6	6	5	8	5	3	8	8	5	5	9	7	10	14	14	12	12	15
Total	**191**	**241**	**201**	**221**	**249**	**188**	**190**	**189**	**241**	**270**	**264**	**268**	**290**	**338**	**272**	**302**	**308**	**272**	**316**	**350**	**376**	**373**	**381**	**417**	**387**	**354**	**276**	**292**	**310**	**232**	**230**	**210**	**169**	**182**

Notes:

- This data consists of the number of people charged for a least one arson related offence.
- If a person receives multiple arson related charges, they are counted in each calendar year that they received a charge outcome.
- A person is counted for the outcome of their most serious arson related charge each calendar year.
- The outcome of a prosecution – whether a person is convicted or not:
  - proved outcomes (where a person is found or pleads guilty) include 'convicted' and 'other proved' (Youth Court proved (s283 order), Discharge without conviction and adult diversion/Youth Court discharge).
  - not proved outcomes include the person being found not guilty and where the charge is withdrawn or dismissed.
  - other charge outcomes including being found not guilty by reason of insanity or unfit to stand trial.

Table 3a (Question 3): Number of people convicted of an arson related offence, by gender and calendar year, from 1985 to 2018

Gender	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Female	9	20	15	16	13	11	11	11	15	22	23	18	16	24	15	17	27	19	23	22	22	20	26	33	27	24	24	31	33	13	20	21	16	22
Male	117	139	123	118	139	106	103	116	117	126	119	125	138	176	132	121	137	117	136	142	145	136	141	179	167	163	108	118	137	113	115	90	79	95
Total	**126**	**159**	**138**	**134**	**152**	**117**	**114**	**127**	**132**	**148**	**142**	**143**	**154**	**200**	**147**	**138**	**164**	**136**	**159**	**164**	**167**	**156**	**167**	**212**	**194**	**187**	**132**	**149**	**170**	**126**	**135**	**111**	**95**	**117**

Notes:

- This data consists of the number of people charged for a least one arson related charge.
- If a person is convicted of multiple arson related charges, they are counted in each calendar year that they received a convicted charge outcome.
- A person is counted by the gender recorded for their most serious convicted arson related charge that year.

Table 3b (Question 3): Number of people convicted of an arson related offence, by ethnicity and calendar year, from 1985 to 2018

Ethnicity	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
European	88	110	90	80	110	72	73	78	94	85	90	91	90	135	92	92	97	90	105	100	100	97	90	133	116	112	83	94	92	81	79	63	50	64
Maori	29	43	42	50	38	41	36	38	30	56	39	41	49	50	43	34	56	32	45	57	49	47	65	69	65	63	35	43	60	35	42	46	41	45
Pacific Peoples	8	2	3	4	3	1	3	7	5	5	8	7	10	10	8	8	9	9	5	3	11	7	7	7	7	10	8	8	9	4	10	2	2	7
Asian	0	0	1	0	1	0	0	2	1	0	2	2	1	0	3	3	0	4	2	2	2	2	0	1	1	2	2	2	7	5	3	0	1	1
Other	0	3	1	0	0	2	1	1	0	1	2	2	3	4	1	1	2	1	2	2	4	2	4	0	1	0	4	2	1	0	1	0	0	0
Unknown	1	1	1	0	0	1	1	1	2	1	1	0	1	1	0	0	0	0	0	0	1	1	1	2	4	0	0	0	1	1	0	0	1	0
Total	**126**	**159**	**138**	**134**	**152**	**117**	**114**	**127**	**132**	**148**	**142**	**143**	**154**	**200**	**147**	**138**	**164**	**136**	**159**	**164**	**167**	**156**	**167**	**212**	**194**	**187**	**132**	**149**	**170**	**126**	**135**	**111**	**95**	**117**

Notes:

- This data consists of the number of people convicted of at least one arson related charge.
- If a person is convicted of multiple arson related charges, they are counted in each calendar year that they received a convicted charge outcome.
- A person is counted by the ethnicity recorded for their most serious convicted arson related charge of that year.

Table 3c (Question 3): Number of people convicted of an arson related offence, by age bands and calendar year, from 1985 to 2018

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
19 years and under	60	69	52	52	63	35	45	39	44	48	48	51	45	70	50	45	48	34	51	67	57	61	57	78	73	81	39	47	43	26	20	18	18	20
20-24	37	55	41	33	42	29	36	40	39	38	47	42	44	45	35	33	33	41	36	24	30	26	45	41	41	42	32	35	34	30	28	24	15	22
25-29	4	11	20	14	16	19	17	21	20	31	15	15	27	31	28	20	22	11	13	27	23	18	13	15	27	15	22	17	22	15	25	20	14	19
30-34	8	9	11	17	12	14	7	9	16	15	11	15	14	20	12	9	22	14	22	18	15	18	17	15	18	15	11	14	15	7	9	18	9	14
35-39	7	8	5	6	9	9	4	7	6	6	7	10	13	16	12	16	15	11	15	13	19	10	16	24	13	15	2	13	11	10	21	11	12	16
40-44	2	4	3	2	4	5	3	4	2	6	11	7	3	5	6	10	11	8	12	11	8	10	8	20	11	11	11	11	18	13	10	5	8	8
45-49	6	1	2	3	3	4	1	4	2	2	1	1	4	6	3	4	10	7	6	2	7	8	5	9	0	3	7	6	12	12	11	7	9	10
50-54	2	2	2	4	2	2	1	1	1	0	1	2	2	5	1	1	3	3	0	1	7	2	0	6	6	1	2	3	8	7	4	4	7	4
55-59	0	0	2	1	0	0	0	1	0	0	0	0	2	1	0	0	0	5	2	1	1	2	4	1	4	2	3	1	4	4	2	3	1	3
60-64	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	1	2	2	2	0	3	1	1	0
65 years and over	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	0	1	1	0	0	0	2	2	0	1	1	0	1	1	2	0	1	1
Unknown	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
Total	**126**	**159**	**138**	**134**	**152**	**117**	**114**	**127**	**132**	**148**	**142**	**143**	**154**	**200**	**147**	**138**	**164**	**136**	**159**	**164**	**167**	**156**	**167**	**212**	**194**	**187**	**132**	**149**	**170**	**126**	**135**	**111**	**95**	**117**

Notes:

- This data consists of the number of people convicted of at least one arson related charge.
- If a person is convicted of multiple arson related charges, they are counted in each calendar year that they received a convicted charge outcome.
- Age is the person's age at the offence date of their most serious convicted arson related charge that year.

APPENDIX B

Recoding of Variables (Edwards & Grace, 2014)

Recoded Variables	Recoded Values					
Prior offence types	0	1	2	3	4	5
Age at first arson		≥30	≥25	≥18	<18	
Age at first offence		≥30	≥25	≥18	<18	>19
Number of prior violent	0	1	≥2			
Number of prior vandalism	0	1	2	≥3		
Number of prior theft	0	1	2	≤4	≥10	
Number of prior drug	0	1	2	≥3		
Number of prior driving	0	1	2	≥3		
Number of prior all	0	1	4	≤10	≥20	

Note. These recodings were used to generate the predictor variables for the Cox regression analyses.

APPENDIX C

Evidence of Ethical Approval

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Lynda Griffioen
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2013/143

29 November 2013

Michael Edwards
Department of Psychology
UNIVERSITY OF CANTERBURY

Dear Michael

The Human Ethics Committee advises that your research proposal "Risk assessment of convicted arson offenders" has been considered and approved.

Please note that this approval is subject to the incorporation of the amendments you have provided in your email of 26 November 2013.

Best wishes for your project.

Yours sincerely

Lindsey MacDonald
Chair
University of Canterbury Human Ethics Committee

APPENDIX D

Predictive Models (Edwards & Grace, 2014)

Arson Model

Predictor Variables	*B*	SE	Wald	df	Sig.	Exp(*B*)
First arson < 18-years	.92	.32	8.05	1	.005	2.51
Multiple arsons	1.18	.33	12.72	1	.000	3.27
Number prior vandalism	.34	.15	5.14	1	.023	1.41

Violent Model

Predictor Variables	*B*	SE	Wald	df	Sig.	Exp(*B*)
First arson < 18-years	.42	.15	8.28	1	.004	1.53
Age at first offence	.40	.12	11.40	1	.001	1.50
Number prior violent	.32	.08	17.48	1	.000	1.37
Number prior all	.19	.07	7.17	1	.007	1.21

Non-violent Model

Predictor Variables	*B*	SE	Wald	df	Sig.	Exp(*B*)
Age at first arson	.33	.05	42.99	1	.000	1.40
Number prior theft	.22	.03	44.76	1	.000	1.24
Number prior drug	.12	.04	7.91	1	.005	1.13